JUST-IN-CASE OR JUST-IN-TIME: TOTAL ASSET VISIBILITY AND JUST-IN-TIME DISTRIBUTIONS IMPACT ON FUTURE CLASS IX REPAIR PARTS OPERATIONS IN US ARMY COSCOMS AND DISCOMS

A MONOGRAPH
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ABSTRACT

JUST-IN-CASE OR JUST-IN-TIME: TOTAL ASSET VISIBILITY AND JUST-IN-TIME DISTRIBUTIONS IMPACT ON FUTURE CLASS IX REPAIR PARTS OPERATIONS IN US ARMY COSCOMs AND DISCOMs by Franklin D. Roach, USA, 80 pages.

Under public pressure to reduce defense spending and a Congressional demand for increased efficiency created by the collapse of the Soviet Union during the early 1990's, the United States Army has repeatedly been accused of maintaining unnecessary and expensive inventories of class IX repair parts throughout its supply system. In contrast, private industry has dramatically reduced its repair parts inventory levels, while reducing order ship times for arrival of repair parts by a combination of two initiatives called Total Asset Visibility (TAV) and Just-in-Time Distribution (JIT).

This monograph examines the question: can implementation of TAV and JIT systems and methods in US Army COSCOMs and DISCOMs improve class IX repair parts receipt, storage, issue and transportation, while increasing customer satisfaction and providing cost savings in personnel and equipment? To accomplish this task, the monograph first defines TAV and JIT. and discusses the historical development of US Army tactical class IX repair parts operations to include: force structure, current doctrinal missions and responsibilities in the COSCOM and DISCOM. The monograph then discusses the history and use of TAV and JIT in civilian industry. Next, the monograph compares and contrasts the civilian industry and the US Army standards used by the COSCOM and DISCOM for inventory control, storage, issue, receipt and transportation of repair parts and discusses the reasons for their differences. After this comparison, the monograph uses four of the nine Army Principles of Logistics: Logistics Intelligence, Simplicity, Timeliness and Cost Effectiveness, to evaluate historical examples of COSCOM and DISCOM class IX repair parts operations in Operations Desert Storm/Shield, Operation Restore Democracy and comments on current reports from Operation Joint Endeavor. Based on this analysis, and the results of the comparison of the civilian industry repair parts operations and standards versus US Army COSCOMs and DISCOMs, the monograph concludes that implementation of JIT systems and methods will provide the asset visibility, flexibility and cost effectiveness needed to support future Army class IX repair parts supply and distribution. Finally, the monograph provides recommended changes in the organizational structure, missions and methods for class IX repair parts operations in the US Army COSCOMs and DISCOMs.

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INTRODUCTION

THE ARMY CHALLENGE

> "At the conclusion of the Cold War we have found ourselves with too much of not the right stuff, outdated information management tools, and organic capabilities that didn't address contemporary needs. The passing of the Cold War and the strategy we embraced to fight it, if nothing else, demands a fundamental rethinking of our supporting logistics strategy and reengineering of our logistics systems processes, capabilities and inventories."[1]
>
> Honorable Paul G. Kaminski
> Under Secretary of Defense for Acquisition
> and Technology

Much has been written on the US Army's strategic and operational ability to supply, move and sustain military operations. The US Army's past history from World War II, Korea, Vietnam, Operations Desert Shield/Storm, and Operation Restore Democracy provide a plethora of colorful analogies touting the success of the US Army's logistical might. Newspaper articles, media reports, and initial after action reviews are filled with this type of logistical analysis. Recent examples from the Operations Desert Shield/Storm and Operation Restore Democracy provide a sample of these reports. In his book, Moving Mountains, Lieutenant General Gus Pagonis, the Commander of the 22d Support Command, whose logistical command was responsible for support of the Gulf War, describes some of the US logistical accomplishments:

> "Running Logistics for the Gulf War has been compared to transporting the entire population of Alaska, along with their personal belongings, to the other side of the world, on short notice. In the year between August 1990 and August 1991- that is, before, during, and in the wake of the Gulf War- the logisticians of the 22d Support Command and the 1st and 2d COSCOMs, provided enough meals to feed all the residents of Wyoming and Vermont three meals a day for forty days. Those same units pumped fuel equivalent to seven times the fuel consumption of Washington D.C. in the same period- and roughly equal to the 12 month fuel consumption of the District of Columbia, the states of Montana, and North Dakota combined. In that same one-year

> span, those units and their contracted drivers drove the equivalent of more than 100 round-trips to the moon; or more than 2,000 trips around the world; or more than 10,000 round-trips from Los Angeles to New York. For half a year from November 1990 through April 1991, the suppliers and transporters of the Gulf War handled an amount of mail that would cover twenty-eight football fields in mail six foot deep." [2]

More recent examples of this reporting come from the 1st Corps Support Command (COSCOM) located in Fort Bragg, NC, which was responsible to provide logistical support for all ground forces during Operation Restore Democracy. During a press release given to reporters in Haiti, 1st COSCOM Commander, Brigadier General John McDuffie described the 1st COSCOM units' logistical accomplishments during the period 10 September through 23 October 1994.

> "Up to this point in the operation, soldiers of the 1st COSCOM have provided enough fuel to the Haitian Government in support of Operation Lightswitch equivalent to providing a 747 with enough fuel to fly around the earth twenty -seven times. These same soldiers have offloaded enough pieces of equipment and containers- an amount that would be equivalent to a convoy of vehicles and equipment that would span along highway Interstate 95, from Baltimore to New York City." [3]

While amusing, these facts do little to enhance the critical analysis of some of the important issues associated with tactical logistical support of modern US Army operations.

Historically, since 1941 US Army logistics operations for supplies including class IX repair parts, were maintained by shipping and stockpiling excess repair parts throughout the army, corps and division level supply system.[4] Repair parts stockpiles were used to reduce the reliance on the class IX supply system during contingencies, supply shortages, transportation restrictions, or periods of financial constraint.[5] This type of supply system, while effective in moving massive amounts of strategic and operational level supplies of repair parts into a theater of operations, failed to maintain accountability of these stocks down through the corps

and division level. Loss of accountability led to excessive stockpiles of unidentified class IX repair parts, an ineffective distribution down to the units needing them, and most critical, a loss of confidence in the supply system by the supported units. The consequences of this class IX supply system created unit supply shortages although stocks of the needed parts sat unused in the theater.[6]

Current US Army class IX supply system at corps, the Corps Support Command (COSCOM) and division, the Division Support Command (DISCOM), remains plagued with these same problems faced by its World War II predecessor. Current observations of a battalion executive officer of the US Army's 181st Transportation Battalion, which was responsible to transport supplies to units in Operation Joint Endeavor, clearly demonstrate the US Army's continued failure to break these paradigms.

> "One of the difficulties associated with the deployment stage of Operation Joint Endeavor was the relatively large number of unidentified cargo containers which dotted the landscape. Due to the operation's tempo, immoderate weather and frequent changes in the mission and locations of units, containers sometimes lost their identity. This delayed the delivery of vital spare parts for key non-mission capable systems and eroded readiness task force wide." [7]

However, like the inevitable march of time, the changing world since World War II continues to demand even higher levels of support from the US Army class IX repair parts supply system.

Levels of support from the class IX repair parts supply system are impacted by many factors. The first factor is the relative higher cost for newer more complex class IX repair parts.[8] Decrease in the relative cost of commercial transportation of repair parts compared to the US Army is the second factor.[9] Decline in the US Army's current military budget is the third factor that affects the class IX repair parts supply and distribution system. Since 1985, the budget has declined twenty-four percent from 82.3 billion to 62.7 billion dollars, while operations requiring class IX repair parts have increased 300 percent. Finally, the factor of the normal

costs associated to maintain soldiers that execute the receipt, storage and issue of class IX operations in corps and divisions have risen.[10] These factors, while justified in the past by the US publics view of the potential threat posed during the Cold War by the former Soviet Union, are no longer seen as a good investment for the US peacetime tax dollars.[11]

The US Army class IX repair parts system has some specific problems that must be addressed in future changes. Compared to the relative costs of repair parts during World War II, the US Army's modern weapons systems now require repair parts that are far more expensive.[12] Second, from 1941 to today the lack of repair parts accountability and inefficient use of the US Army's transportation system to distribute repair parts, continue to fail to meet the needs of the combat units.[13] Finally, unchanged from its World War II predecessor, the current US Army repair parts supply system still relies on duplication of effort in the receipt, storage, issue and transportation of repair parts.

While stockpiling massive inventories of class IX repair parts has worked in the past, such supply practices can no longer be relied upon to sustain current US Army equipment and weapons systems during future operations.[14] Thus, the rising costs of class IX repair parts, duplication of force structure in the receipt, storage, issue and transportation of repair parts, compared to its civilian counterparts has impeded rather than facilitated US Army military operations.

These challenges have come at a unique time in our nations history. In the words of the late NATO Secretary General, Manfred Worner, "The collapse of the Soviet Union has left us with a paradox: there is less threat but also less peace."[15] Under this context, starting in the early 1990's, the US public and Congress has increased pressure to reduce defense spending and increase efficiency. As this request for the "peace dividends" resulting from the demise of the Soviet Union has increased, the US Army has repeatedly been accused of maintaining

billions of dollars worth of unnecessary and expensive inventories of class IX repair parts throughout its supply system.[16]

In contrast to the US Army, private industry during the mid 1980's instituted dramatic changes in the area of inventory management and material distribution. Private industry dramatically reduced its supply inventory levels to include repair parts, while reducing order ship times for arrival of repair parts.[17] Industry leaders in repair parts management such as Caterpillar Corporation, Toyota Motor Corporation, General Motors Corporation, Boeing Aerospace Corporation, International Business Machine Corporation and Freightliner Corporation have joined efforts with civilian transportation experts, Federal Express and United Parcel Service Corporation to resolve the problems of receiving, storing, issuing and transporting repair parts. This was accomplished through a combination of two initiatives called Total Asset Visibility (TAV) and Just-In-Time distribution (JIT). By implementing these initiatives corporation's have reduced inventory costs by as much as fifteen to twenty percent, while simultaneously reducing the amount of business lost because of failure to supply repair parts to customers in a timely manner. Additionally, by using TAV and JIT these corporations inability to respond in a timely manner for emergency supply requests has decreased by as much as fifty to seventy-five percent.[18]

TAV is defined as the capability to provide timely and accurate information on the location, movement, status and identity of personnel, equipment and supplies, combined with the ability to act on that information to improve the overall performance of logistics practices. TAV also includes the ability to provide timely and accurate information on the status of supply requisitions.[19] JIT is the capability to quickly process and economically transport requests for personnel, equipment, and supplies to the customers at the right place and the right time.[20] These initiatives have saved billions of dollars in cost avoidance and increased efficiency in

repair parts management. Improvements from TAV and JIT include: elimination of manual tracking of shipments, reduction of on hand inventories, reduction of personnel required to receipt, store and issue inventories, increased reliability of on time deliveries, and a reduction of overall transportation time and cost for shipment of repair parts to almost anywhere in the world.[21] JIT and TAV definitions vary, depending on the individual company. For the purpose of this monograph, the term (JIT) represents both the visibility of material flow (TAV), and a logistics system (JIT) that is characterized by minimum inventory, faster more frequent transportation shipments, and a pulled rather than pushed material flow.

The dramatic successes with JIT by Caterpillar Corporation, Toyota Motor Corporation, General Motors Corporation, Boeing Aerospace Corporation, Federal Express and United Parcel Service Corporation, have demonstrated that "Just-In-Case" stockpiling of repair parts is no longer required or efficient. With full implementation of JIT systems and principles, the COSCOM and Division Support Command (DISCOM) can reduce inventories in the class IX repair parts, cut force structure in the units that receive, store, and issue class IX repair parts, improve delivery times for repair parts to supported units, and improve customer confidence in the supply system.

This monograph focuses on the US Army's ground class IX repair parts supply system at the tactical level of operations, which is supported by the supply support activities (SSAs) in the COSCOM and DISCOM. Section II discusses the historical development of COSCOM and DISCOM class IX operations to include: force structure, past and current doctrinal missions of the units responsible for class IX repair parts in the corps and division, and the history and use of JIT in civilian corporations. Section III defines and compares and contrasts the civilian industry and the US Army standards used by COSCOMs and DISCOMs for receipt, storage, issue and transportation of repair parts. The author then offers reasons for the different

standards and analyzes the impact of these differences. Section IV uses four of the nine US Army Principles of Logistics set forth in US Army Regulation 11-8, Principles and Policies of Army Logistics, to evaluate historical examples of COSCOM and DISCOM class IX operations during Operations Desert Shield/Storm, Restore Democracy and comments on the ongoing repair parts missions in Operation Joint Endeavor. The four principles are listed below:[22]

LOGISTICS INTELLIGENCE: Commanders must have accurate and timely logistics information in order to provide effective support
SIMPLICITY: Simplicity is essential at all levels of the logistics system.
TIMELINESS: Logistics support must be provided in the right quantity and at the proper time and place for accomplishment
COST EFFECTIVENESS: Efficient management of Logistics resources is essential to cost-effective logistic support.

Finally, Section V recommends changes based on JITs potential impact on the class IX repair parts operations in the COSCOM and DISCOM.

CHAPTER II

HISTORY OF LOGISTICAL CONFUSION

> "In my forty-eight years in defense logistics, seven in combat zones in three different wars, I've faced different serious logistics problems. In each war, because supplies were low or nonexistent, or could not be located, we lost critical time getting the support required to the combat troops. The worst situation is to arrive at combat with an excess of noncritical items and a shortage of critical items. For five years we struggled to determine what we had on shore on Vietnam."[23]
>
> Lieutenant General (Ret.) Joseph Heiser, in his book A Soldier Supporting Soldiers, describing his experiences in World War II, Korea and Vietnam.

Modern US Army tactical level class IX repair parts supply and distribution management began in 1941. Fueled by the new mechanization of weapons and equipment, the US Army now required a more responsive repair parts supply and distribution system to maintain equipment readiness at tactical level. This new requirement for a more responsive repair parts supply and distribution system to support US Army military operations required changes at tactical level. The development of these changes in 1941 began the history of modern US Army corps and division repair parts operations.[24]

While the new increase in mechanization of modern weapons and equipment fueled changes in the US Army corps and division repair parts operations, the operational conditions under which US Army soldiers conducted class IX supply operations demonstrated inherent systemic problems. The following vignette provides an example of a common class IX resupply operation between a corps class IX supply company and a division supply company.

The young US Army driver pulled up to the single strand of concertina wire loosely strung across the dirt road leading to the checkpoint of their corps supply storage area. Slowly he dismounted his vehicle and began to exchange some small talk and a cigarette with the Army private standing guard at the entrance point. "You guys got anything for us today?" remarked the driver to the private occupying the gate. "I'm not sure" replied the private, "but we

did get a whole bunch of 'stuff' in from the seaport and the airfield yesterday." "Heard any news from the front on when this operation might end and we can go home?" the gate guard asked as he pulled the concertina wire clear from the road. "No, I have not" replied the driver. The truck slowly lurched forward down the road to where the US Army 10th Corps kept its class IX supplies. After five minutes they arrived at the weathered tent that housed the senior noncommissioned officer (NCO) of the General Support Repair Parts Company, which is responsible for receipt, storage and distribution of each of the division's and the corps unit's class IX supplies.

As the driver and the assistant driver slowly climbed out of the truck, both gazed in amazement as they began to see the "mountains of stuff" as they described it. For as far as their eyes could see there were rows of twenty and forty-foot military connexes and piles of equipment stacked up three high. "How many football fields of 'stuff' do you think are in here today?" the assistant driver asked the driver. "I'm not sure" replied the driver; "maybe ten to twelve long by three or four wide today" replied the assistant driver. As they stepped into the tent, they observed other divisional "customers" as supply units commonly describe them, talking to the different soldiers and NCOs working in the corps supply operations. The assistant driver stepped up to the wooden table and asked the senior NCO, "have any repair parts for my division arrived since yesterday?" "I'm not sure" the senior NCO quickly remarked. "The company soldiers have not had a chance to open all the shipments that have arrived in theater since they started this operation more than two weeks ago." Further he stated, "Once they open them, they still have to identify what is in them, inventory the contents, and then store them in the appropriate areas designated for the separate units and the corps reserve stocks. However, you and your driver are welcome to go with my soldiers working in the supply yard to look for any critical items you might need. If you find them, my soldiers will process it for you against your requisitions." Both the driver and the assistant driver looked at each other, and after a short conversation remarked, "No, that's all right, we will be back again tomorrow."

The vignette above provides a realistic example of the operational difficulties and conditions that US Army's supply units face during corps and divisional class IX supply operations. Recent reports from Operations Desert Shield/Storm, Operation Restore Democracy and the current US Army's Operation Joint Endeavor in Bosnia highlight the US Army's continued problems in the same accountability, distribution and transportation problems of their World War II predecessors.[25]

Origins of the current US Army class IX repair parts supply system began during the build up for World War II late in 1941. During this period, the US Army implemented a comprehensive supply management program to control the production, distribution and cost of the massive amounts of mechanized equipment being produced for the war effort.[26] This large

amount of mechanized weapons and equipment created unprecedented requirements for repair parts supply and distribution to keep these weapons and equipment operating.[27]

Beginning in 1941 through 1969 the US Army classified supplies into five class designations.[28]

US Army Classes of Supply
World War II / Korea / Vietnam (pre 1969)

Class I Supplies	Those articles which are consumed at an approximate uniform daily rate irrespective of combat operations or terrain and which do not necessitate special adaptation to meet individual, such as rations and forage.
Class II Supplies	Those authorized articles for which allowances are authorized by the Tables of Basic Allowances and Tables of Equipment such as clothing, gas masks, arms, trucks, radio sets, tools, and instruments.
Class III Supplies	Fuels, and lubricants, including gasoline for all vehicles except aircraft. Diesel oil, fuel oil, and coal.
Class III (A) Supplies	Aviation fuels and lubricants.
Class IV Supplies	Those articles of supply which are not covered in Tables of Basic Allowances and demands for which are directly related to operations contemplated or in progress (except for articles in classes III and V), such as fortification materials, construction materials, and machinery.
Class IV (E) Supplies	Complete airplanes, and all spare parts required to maintain the complete airplane in commission.
Class V Supplies	Ammunition, pyrotechnics, antitank mines and chemicals.

Repair parts supplies from 1941 through 1969 were classified under two separate listings depending on whether they were for the US Army air planes or ground systems. Class IV (E) supplies were repair parts used to maintain aircraft. Class II supplies were repair parts used to

maintain all ground systems that included: wheel and track vehicles, tanks, weapons, artillery, or any other equipment not class IV construction and barrier material.[29] This classification system was primarily developed to assist those personnel assigned the responsibility to receipt, store and issue US Army supplies.

Receipt, storage and issue of repair parts during World War II and the Korean War was primarily the responsibility of the US Army Quartermaster (QM) Corps. From army, corps and division level, supply of repair parts was normally handled by two different QM supply operations. At the army level, QM supply companies' primary responsibility was to supply repair parts to their respective divisions. At corps level, QM supply companies handled the responsibility for supply of repair parts to corps troops only.[30] In an emergency, the corps commander could provide supplies to his subordinate division from the corps supply depots. Divisions were then responsible for their own internal distribution of supplies to their subordinate units.

At the army level, one QM company Table of Organization and Equipment (T/O&E) 10-227, depot supply was responsible for receiving, storing, and issuing repair parts to its subordinate divisions, corps, and army troops.[31] The company consisted of eight officers and 178 enlisted soldiers. The company's mission was to receive, store and issue class I and II supplies for up to 60,000 soldiers and their equipment. To accomplish this mission, the company was routinely augmented with technical advice, labor and transportation from two QM service companies and one QM truck company.[32]

At corps level, one QM supply company, T/O&E 10-197, was normally responsible for receiving, storing and issuing repair parts to the corps troops.[33] The company consisted of four officers and 173 enlisted soldiers. The company mission was to receive, store and issue all classes of supplies, to include repair parts, minus class V for all assigned soldiers and

equipment in the corps troops.

At division level, the QM supply units responsible for receiving, storing, and issuing repair parts varied depending on the type of division they were assigned to support. Light infantry and airborne divisions were assigned one QM supply company, T/O&E 10-17, and 10-327 respectively. Each company consisted of ten officers and 176 enlisted soldiers. The units' mission was to handle all their respective division's supplies, to include repair parts. Mechanized and armored divisions, were serviced by an entire QM battalion T/O&E 10-35, and 10-315 respectively due to their increased size and supply requirements. Each QM battalion consisted of three or four companies, (T/O&E 10-17) that were augmented with increased internal transportation assets assigned for better mobility.[34]

Once the assigned QM units received and stored these repair parts, repair parts were issued to the appropriate echelon of ordnance (equipment maintenance) unit (OEM). Upon issue of the repair parts from the appropriate QM company, the OEM unit was responsible for storing and issuing these parts to their subordinate army, corps or division OEM units. Subordinate OEM units would then issue these repair parts to the units or soldiers conducting equipment repairs, or to maintain their units' repair parts inventories. This class IX repair parts supply system developed in 1941 remained relatively unchanged until the late 1960's.

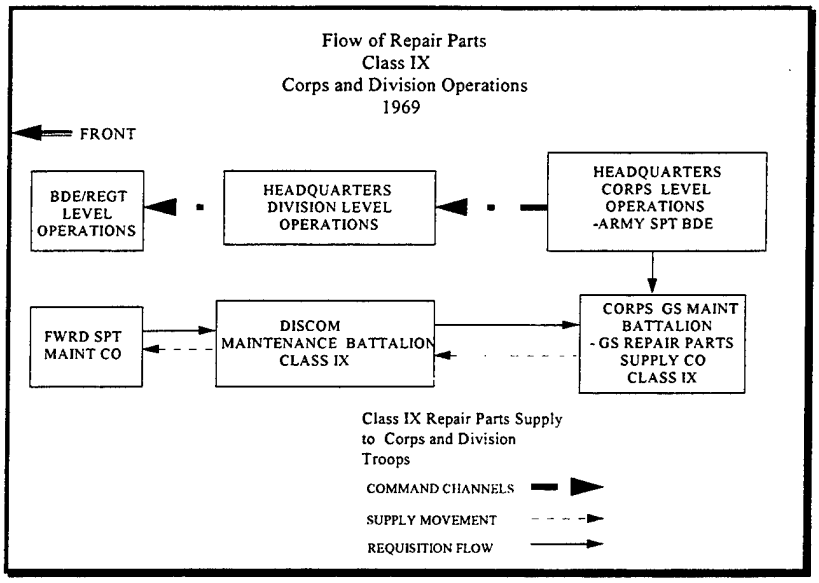
In response to the continuing criticisms of waste, abuse and inefficiency in the US Army's repair parts supply and management system during World War II and the Korean War, the US Army began a series of studies on the problems from 1958 through the mid -1960's. Agencies to include the Government Accounting Office (GAO), RAND, the Department of Defense (DOD) and the individual Armed Services began a comprehensive analysis of both the US Army and DOD repair parts management system. Results of the studies demonstrated systemic problems in receipt, storage, issue, accountability, transportation and distribution of repair parts

in the US Army and the DOD.[35]

In addition to the results of these studies, reports of repair parts supply problems in the US Army in Vietnam in 1965, and field experiences of the 7th US Army, Europe were analyzed for problems.[36] Results of these government studies and the recent experiences of US Army units in Vietnam and Europe were published in a DOD report in January 1967 titled "The Department of the US Army Board of Inquiry on the US Army Logistics System." This report prompted the first significant changes in the US Army repair parts supply and distribution system since 1941.

Change to the US Army repair parts supply and distribution system began with the implementation of "The Army Support Brigade Concept (ASB)."[37] This new concept now placed the corps, instead of the field army, as the US Army's primary headquarters responsible for all logistical support at tactical level within a theater of operation to include class IX repair parts. The ASB would service both army and corps troops from the division rear boundary to the army rear boundary. One ASB was employed per corps. Changes in the ASBs command and control, provided a more direct and efficient reporting and distribution system.

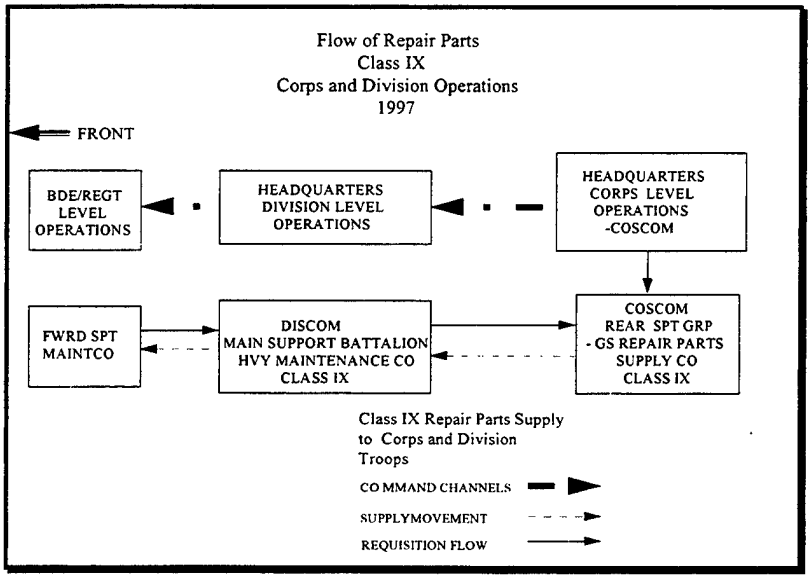
Further changes to the US Army repair parts supply and distribution system included moving the control of general support (GS) repair parts companies from the QM supply and service battalion to the OEM battalions. This change was made to improve repair parts supply responsiveness, and make the GS repair parts company the sole unit responsible for receipt, storage and issue of all repair parts from outside the theater to its assigned corps and divisions. Division level changes eliminated QM supply battalions from the division force structure, and relocated the repair parts management functions of receipt, storage and issue of repair parts from QM companies to the OEM companies within the DISCOM.[38] (Reference the diagram)



In 1970, the ASB concept underwent two additional minor changes that brought it to its current 1997 configuration. First, the ASB was renamed as the Corps Support Command (COSCOM). Second, the COSCOM organization (T/O&E 63422I000) was reorganized into a corps level headquarters. Both of these changes were part of the US Army's continued effort to align the supply and distribution system to support the corps and division forces.

The COSCOM mission is to provide corps forces with all logistical support required to sustain high levels of combat over the duration of major operations or the current operational plans of unified or joint commands. The COSCOM headquarters commands from three to seven assigned logistics battalions. Each battalion is organized under a brigade level equivalent Corps Support Groups (CSGs) (T/O&E 63422L000). CSGs do not have a standard organizational structure. They are further organized into either a forward CSG and or a rear CSG. CSGs operate in support of corps units and their supported divisions. In order to maintain flexibility the COSCOM commander can tailor the CSGs or the subordinate battalions and companies based upon the logistical mission.[39]

Organizational and command and control changes from the 1941 repair parts supply and distribution system up through the ASBs, and finally in the COSCOMs have improved the US Army class IX repair parts supply system. However the systemic problems associated with the receipt, store, issue and transportation of class IX repair parts operations and the basic organizational structure remains virtually unchanged in 1997 from it's ASB predecessor.[40] (Reference the diagram below.)



The Department of the US Army Board of Inquiry on the US Army Logistics System also led to a change in the US Army supply classification system established in World War II. The new classification system started in 1969 now classified supplies into ten classes instead of five. This change listed ground and aviation repair parts as class IX supplies.[41] (Reference the diagram below)

CLASSES	SUPPLIES
I	Subsistence, gratuitous health and comfort items
II	Clothing, individual equipment, tentage organizational tool sets and kits, hand tools, administrative and housekeeping supplies and

	equipment
III	Petroleum fuels, lubricants, hydraulic and insulating oils, preservatives, liquids and gases, bulk chemical products, coolants, deicer and antifreeze compounds, components and additives of petroleum and chemical products, and coal.
IV	Construction materials including installed equipment, and all fortification and barrier material
V	Ammunition of all types, bombs explosives, mines, fuses, detonators, pyrotechnics, missiles, rockets, propellants, and other associated items.
VI	Personal demand items such as health, and hygiene products (soap and tooth paste), writing material, snack food, beverages, cigarettes, batteries, and cameras (nonmilitary sales items).
VII	Major end items such as launchers, machine shops, and vehicles.
VIII	Medical material, including repair parts peculiar to medical equipment.
IX	Repair parts and components to include kits, assemblies and subassemblies (repairable and non-repairable) which are required for maintenance support of all equipment.
X	Material to support nonmilitary programs such as agriculture and economic development (not included in Classes I through IX).
Miscellaneous	Water, maps, salvage, and captured material.

Current methods used by the US Army in the COSCOM and DISCOM to distribute repair parts began immediately before World War II in 1940. This quotation from FM 100-10 Field Service Regulation dated 1940 describes the primary concept for distribution in supply operations:

> "The impetus of supply operations is from front to rear. It is the function of each element in the supply chain to push supplies forward within reach of the elements in the front."[42]

To move supplies, to include repair parts, the US Army developed three distribution methods. The first method involved a "push system." The push system was designed to

automatically supply units based on their unit type without unit requisitions.[43] This system was unsuccessful in supplying units at tactical level. Indiscriminate shipment of supplies to units regardless of their mission or location on the battlefield left shortages of supplies in some units while other units had excesses.[44] "Pull system" the second supply method relied on units submitting a request for the required item into the supply system before the supplies were shipped. This system also failed to adequately supply units at tactical level. Inability to timely move supplies throughout the system left shortages of supplies in some units while others had excesses.[45] The third system used and finally adopted throughout the US Army late in World War II was the "push-pull system." This system relied on a combination of unit requests (pull) and automatic (push) shipments of supplies to satisfy unit needs. This supply distribution system, while a slight improvement over either of the two systems by themselves, was still ineffective and failed to meet tactical unit supply needs in a timely fashion.[46]

Continued failure of the US Army supply and distribution system to meet tactical unit needs was caused by the US Army's inability to correct problems in asset visibility, and institute a timely distribution system capable of delivering supplies to include repair parts, to the right place and at the right time. While the push-pull system was a slight improvement in supply operations, it did not always provide responsive support of tactical operations. Support problems caused by lack of accountability is best described in the Army Service Forces own maxim that guided operations throughout World War II and Korea:

> "Because of the urgency of war, the impossibility of accurate forecasting, and the unexpected shifts in operational demands, it is better to have too much than to have too little."[47]

This maximum of excess supplies conflicts directly with the push forward distribution concept. By pushing excess supplies without accountability into an overburdened transportation system, the supply system became slow and inefficient leading to shortages in some areas while

excessive stockpiling of supplies occurred in others.[48] Unfortunately, the US Army's push-pull supply distribution of repair parts, combined with its problems of accountability, receipt, storage, issue and transportation continue in the current US Army tactical level class IX repair parts supply and distribution system.[49]

While the problems of the US Army tactical level class IX repair parts supply and distribution system still exists today, many studies and articles written since World War II through 1997 have identified the necessary changes to the system.[50] However, it is apparent by studying the current US Army FM 100-10 Combat Service Support in Annex A 3, B 3, and C 6, 7, that little of these recommended changes have occurred.[51] Current COSCOM and DISCOM organizational structures and their class IX repair parts supply and distribution methods still have the same systemic problems as the US Army class IX repair parts supply and distribution system of World War II.[52] These continued systemic problems can be corrected. Unlike the US Army class IX repair supply and distribution history, civilian industry has made significant improvements in the receipt, store, issue and transportation of supplies to include repair parts through implementation of JIT methods.

Early histories of JIT methods in civilian industry are often thought of as recent. A common misconception is that the Japanese invented the JIT concept in the 1980's. Actually, JIT methods began in the United States with Henry Ford during the 1920's. Using a combination of integrated production and assembly plants, Ford coordinated to have iron ore arrive by tanker, and within one day turn it into steel in one of his steel plants. Steel was then stamped or molded into autoparts that were finally assembled within a few days of the arrival of the tanker of iron ore and distributed to salesman.[53] Early US industries did not take advantage of Ford's JIT methods and discontinued their use.

Reemergence of JIT methods in civilian industry's supply management and distribution,

came about as the result of civilian industry having the same systemic problems in the receipt, storage, issue, accountability and transportation of repair parts faced by the US Army from World War II through the late 1950's. Unlike the US Army's systemic supply and distribution problems that occurred during the tense Cold War period of the late 1950s and early 1960s, the civilian industry problems began in what was a period of relative business prosperity. During the late 1950's the civilian industry's overproduction of goods, combined with excess capacity began to produce excess throughout the supply distribution system and in the stores.[54] This excess in repair parts supplies, as in the US Army repair parts supply system, did not produce the anticipated increases in operational readiness of equipment, or improve equipment repair times.[55]

In response to this systemic problem, Motorola Corporation began a test project to resolve their repair parts supply and distribution problems. Starting in 1956, they moved their radio repair parts stocks to a centralized location. Then, by using a combination of fast communications and transportation, they provided parts from this central location to the required locations. This project proved so successful that within a few months operational readiness rates of radios had improved thirty percent. This successful experiment provided the recent genesis for JIT inventory and management that some claim was the invention of the Japanese in the 1980s.[56] While this early project by Motorola Corporation proved JIT successful, interest in JIT methods and systems would again go largely unnoticed for use in the US. However, this early success by Motorola Corporation did get attention from the post World War II Japanese civilian industry.

In the early 1950's, Japanese industry, in an attempt to rebuild their post World War II economy began extensive study of quality control management techniques to include early JIT models.[57] However wide spread implementation of JIT as the Japanese industry standard did

not occur until after the 1973 oil crisis, according to Taichi Ohono, author of Toyota Production System: Beyond Large Scale Production.[58] The 1973 oil crisis caused recession in many countries, including Japan. To resolve the problems caused by the oil crisis Japanese governmental officials searched for solutions to their civilian industry's financial problems. They found their solution in Toyota Motors Corporation. Throughout the period of 1970 through 1973, Toyota Motors became the most financially successful corporation in Japan. One of the major reasons cited by Toyota for their success was JIT systems. Toyota used JIT systems throughout their receipt, storage, inventory, production, transportation and distribution of supplies to include repair parts to its customers. By using JIT systems Toyota increased, company profits while reducing costs and improving customer satisfaction despite the oil crisis. This revelation from Toyota caused the rest of Japanese industry to quickly follow Toyota's lead and adopt JIT methods.[59] While the Japanese quickly became the worlds' leader in JIT, the US industry was slow to follow suit.

American industry did not begin industry widespread use of JIT systems until the late 1980s.[60] Today, however, US corporations such as Caterpillar Corporation, General Motors Corporation, Boeing Aerospace Corporation, and International Business Machine Corporation are now considered JIT industry leaders in repair parts supply and distribution management.[61] Additionally, recent efforts by these corporations to join efforts with civilian transportation experts, Federal Express and United Parcel Service Corporation are now establishing new standards in receiving, storing, issuing and transporting repair parts.[62] Their improvements in JIT have provided millions of dollars in cost avoidance savings from repair parts inventory reductions, reduced work force requirements to receipt, store and issue repair parts, and improved profits from higher customer satisfaction.[63] Similar efficiency and cost savings in the US Army tactical class IX supply and distribution system are possible with JIT implementation.

To demonstrate the US Army's potential improvements at tactical level by full implementation of JIT systems, the following vignette updates the previous example of a typical class IX resupply operation by applying JIT methods and systems.

The young US Army private began his shift at the 21st Division MSB SSA Operations Center at 0730 hours. He immediately logged in to the computer to check the status on the 21st Division' s repair parts requisitions that were due to arrive the night before at the sea port and corps airfield. After verifying both supply shipments were on time, and due to arrive on the ship and airplane, he quickly scanned the corps transportation log to verify the status of the trucks committed to move the supplies from the CSA to the 21st Division's MSB SSA. After verifying the final repair parts shipments arrival time at 1200 hours today, he highlighted the relevant information on the computer screen, moved it into an adhoc rollup report, saved it to a computer disk, then passed the disk to the SSA's Chief Warrant Officer. The chief then reviewed the disk on his computer. After a quick review of the new repair parts status, he then compared this report against the division's critical equipment and weapons systems mission capable status report. He then entered the code allowing this new information to automatically update all the 21st Division's units incoming repair parts status and shipment arrival times. This information also automatically updated the maintenance work orders status of all nonmission capable equipment and weapons systems awaiting repair parts. Within minutes of entering this new information into the computer, the computer software interface network automatically updated the logistics status of every company level unit within the 21st Division. This automated update allowed any commander throughout the 21st Division to access this information on their maintenance computer database. Based on his review of the repair parts supply status and the projected combat operations for the division, the Chief decided to expedite the distribution process of a few selected high priority parts before the scheduled 1200 distribution time. He then sent an e-mail to the General Support Supply Company (GSSC) confirming the ability to pick up the required high priority repair parts. The chief warrant then dispatched a vehicle, driver and assistant driver to pick up the selected class IX repair parts. The GSSC is responsible for the receipt, storage and transportation of the corps unit's and assigned division's class II, IV VII and IX supplies.

The 21st Division MSB SSA driver drove his five ton truck up to the single strand of concertina wire loosely strung across the dirt road leading to the check point of their corps supply storage area (CSA). Slowly he dismounted his vehicle and began to exchange some small talk and a cigarette with the US Army private standing guard at the entrance point. "Heard any news from the front on when this operation might end and we can go home?" The gate guard asked as he pulled the concertina wire clear from the road. "No, not a peep" replied the driver.

The truck slowly lurched forward down the road to where the US Army's 10th Corps received, stored and issued class IX supplies. As the vehicle passed the supply receiving area, the assistant driver observed the large metallic dome beside the road. The metallic dome or "interrogator" as it is commonly called automatically identifies all the incoming supply shipments by electronically querying the data stored in the shipping connex or vehicle's data storage card. This information is automatically transmitted to the GSSC's computer responsible for monitoring the current status of the receipt, storage and issue of supplies including repair parts.

As their five-ton truck entered the distribution area, the driver parked his vehicle next to the GSSC small operations tent. Both the driver and the assistant driver slowly climbed out of the truck. They gazed in amazement as the steady flow of corps and divisions' trucks moving supplies and connexes in and out of the shipping and receiving area stretched down the road. The assistant driver, a veteran of both the Gulf War and Operation Restore Democracy commented to the driver, "I remember when this area would be filled with enough connexes and excess supplies stacked three high to fill ten to twelve football fields long by three or four field wide." Both stepped into the tent, and walked quickly to the two soldiers and one senior NCO directly responsible for controlling the 10th Corps supply and distribution operations. The assistant driver stepped up to the wooden table and asked the senior NCO, if the 21st Division's high priority class IX repair parts were ready for issue. The senior NCO quickly logged on to his computer, and scanned to the class IX field. After entering the 21st Divisions code and verifying the repair parts availability, he nodded his head yes, and remarked that "all the repair parts requisitions have arrived in country." The non-high priority replacement class IX repair parts had arrived as scheduled this morning at the port and are being downloaded for transport to your SSA by 1200. The urgent priority class IX repair parts arrived two hours ago by air, and are currently being uploaded for transport down to your division. However, you and your driver can go with my soldiers working in the supply yard to pick the specific items you might need. Again, he turned to his computer screen, to verify that the repair parts were located at transloading point four. Within fifteen minutes both the driver and the assistant driver picked up the repair parts and headed back to the SSA.

This vignette, provides a realistic look at the millions of dollars of potential cost savings in required personnel and storage, of excess class IX inventories from JIT systems. JIT can improve efficiency, accountability and customer satisfaction in the receipt, storage, issue, distribution and transportation of class IX repair parts. Full implementation of JIT systems in the US Army corps and divisions can provide these savings. While full implementation of JIT systems and methods in the US Army at tactical level seems a simple issue at face value, differences in standards and the goals for supply operations between the civilian industry and the US Army are not so clear.

CHAPTER III

LOGISTICS STANDARDS AND GOALS

> Standard: The accepted example of something against which others are judged; degree quality; weight or measure to which others must conform.[64]

Since the early 1990s, US civilian industry has improved efficiency through widespread implementation of JIT systems in the receipt, storage, issue, distribution and transportation of repair parts. US government officials have questioned why these JIT systems have not been implemented throughout the US Army tactical level supply and distribution system.[65] Why the US Army has not fully implemented JIT systems and methods at tactical level focuses on the differences between US Army and the civilian industry's performance standards and supply system goals. Yet, performance management standards for repair parts operations in civilian industry and the US Army SSAs at corps and division level are similar.

Whether it is a COSCOM GS supply company, DISCOM maintenance company, or a leading automobile manufacturing corporation, the critical management areas for repair parts operations are receipt, storage, issue and transportation. US Army performance standards for all class IX repair parts supply operations in the COSCOM and DISCOM level are found in US Army Regulation 710-2 (AR 710-2), Inventory Management Below Wholesale Level.[66] This regulation provides specific policies and standards that apply for both peacetime and in war. AR 710-2's performance standards are designed as management tools to assess the effectiveness of the US Army's supply and distribution system.

The process that starts the US Army's repair parts supply and distribution system in the COSCOM and DISCOM is the replenishment or request requisition for the repair part.[67] This process places demands or requests for repair parts for SSA stockage or for a weapon system

or piece of equipment that requires a repair part not stocked in the SSA. Requisitions pass via computer disk or electronically from the requesting unit through to the first SSA, up to the GS Supply Company. If the request is not filled at these levels, it will continue to pass electronically from Outside the Continental United States (OCONUS) or inside the Continental United States (CONUS) to the wholesale supply agency. The repair part is then released for issue to the unit that originated the request or replenishment documentation once the requisition reaches the SSA that can fill the requisition.

Receipt is the first management area of focus in tactical US Army supply and distribution operations for class IX repair parts by the supporting units SSA.[68] There are two management standards and one suggested objective in the receipt area. Request processing time is the first management standard. Request processing time is expressed in the number of days from the time the customer's request was received by the SSA to the time the request was processed for issue or passed to the higher supply source. This standard applies to all customer requests regardless of their priority. The US Army standard is two days for request processing time.[69]

Receipt processing time is the second management standard in the receipt area. Receipt processing time is the time expressed in days from the time supplies arrive at the SSA to posting of the receipts to the stock accounting record. Receipt processing time applies to all supplies received by the SSA except for those supplies received without documentation or requiring time identification where research must be conducted. The US Army standard for receipt processing time is three days.[70]

Order ship time (OST) is the management objective used by the US Army in the receipt area. OST measures the actual days that elapses between the document date that the customer's request was received and processed for a non-backordered requisition for a repair part, and the date the repair part is posted as arriving at the SSA supporting the original unit

requisitioning the part.[71] OCONUS OST average is thirty-five days, and CONUS OST average is ten days in 1997.[72] Both of these standards have not significantly improved since 1959.[73]

Storage of class IX repair parts is the second area of emphasis to manage supply and distribution of repair parts operations. Repair parts storage operations involve the act of storing class IX repair parts in a warehouse, shed, open area, or other designated facility. COSCOM or DISCOM units responsible for this mission must inspect, stock, safeguard, and maintain their consigned inventory. These units are also responsible for issuing supplies to authorized customers. Three management standards apply to the storage area of class IX repair parts for COSCOM and DISCOM SSAs.

Inventory accuracy is the first management standard in the storage area. Inventory accuracy represents the number of repair parts on hand having no substantial difference between the dollar value of those repair parts that were inventoried and the dollar value of the repair parts actually on hand. The US Army standard is ninety-five percent accuracy of all the repair parts on hand at the SSA.[74] Demand satisfaction is the second management standard used in the storage area. Demand satisfaction represents the percentage of all valid demands for Authorized Stockage List (ASL) repair parts that are completely filled upon request. Seventy -five percent is the US Army standard at tactical level SSAs.[75] Stockage level is the third storage management standard. Stockage level represents the Days of Supply (DOS) level requirements for stockage of repair parts in the SSAs. DISCOM is authorized a combined total of ten DOS of repair parts stockage combined between the forward maintenance companies in the Forward Support Battalion (FSB) and the heavy maintenance company in the MSB. COSCOM is authorized to store up to thirty DOS of repair parts stockage in the GS supply company.[76]

Issue is the third area of emphasis in the US Army for management of repair parts supply

and distribution operations. No established policy on a management standard for issue of repair parts is established. The US Army assumes that all commanders will coordinate for issue of their repair parts as soon as they arrive at the SSA. However, this assumption is often the exception rather than the rule. Daily supply transactions between the supported units and the SSAs do not always occur. Conflicting mission priorities in the SSAs and supported units, training holidays, weekends, and unit transportation shortages all cause failure in timely issue. Other problems that influence the issue area for repair parts include the SSA's loss of accountability during the receipt and storage of repair parts upon arrival from the higher supply source. Currently, once the repair parts arrive at the supporting SSA, it is the supported units' responsibility to coordinate for issue of the repair part. In an attempt to provide management standards, some US Army COSCOMs and DISCOMs have established local standards that range up to three working days for issue of the repair part after its arrival at the SSA.[77]

Transportation is the final area of emphasis in management of US Army class IX repair parts operations at tactical level. The goal of the US Army supply system is to transport repair parts from higher SSAs directly to the customer requesting units SSA. To accomplish this goal, OCONUS supply activities use consolidation or containerization points (CCPs) to support supply operations. Cargo for OCONUS DS SSAs is first directed to the CCP where the material is containerized or palletized in either vans or 463L pallets. The objective is to unitize (fill vans or 463L pallets) with the specific repair parts for the identified DISCOM or non-divisional SSA.[78] Like the US Army standard for issue, it is assumed that SSAs will transport the repair part supplies as soon as they are received at the SSA or coordinate for the supported unit to provide transportation for issue. Accordingly, the US Army has not established a management standard at tactical level for the transportation area.

Like the US Army, civilian industry corporations also use performance management

standards in the area of receipt, storage, issue and transportation to assess the effectiveness of their supply and distribution systems. However, unlike the US Army AR 710-2, civilian industry performance standards for supply and distribution operations, including repair parts are not published for distribution outside the corporation. Most corporations consider these performance standards as proprietary information.[79]

Receipt of supplies, to include repair parts for civilian industry consists of two specific functions. The first function of the receipt area is the supply request or stock order.[80] This process places an order for an item that is stocked at the corporation's distribution center. Orders are passed electronically from the store, factory and distribution center to a corporate central supply and transportation management center. Stockage of the specific requisitions inventory, and management of the flow of supply shipments are controlled at this center. Stockage information is then transmitted directly to the distribution center that is available to fill the request. Once the request reaches the distribution center, the supplies are released for immediate transportation to the store or factory that originated the order.[81]

Physical receipt of the supplies is the second function of the repair parts supply area of receipt. The first management standard that applies to these functions is order processing time. Order processing time is expressed in the number of days from the time the request was received by the corporations primary distribution control center, to the time the order was processed for shipment. Civilian industry standard for repair parts is one day.[82] Supply processing time is the second management standard in the receipt area. Supply processing time is the time expressed in hours or days from the time supplies arrive at the factory or store, to posting of receipt of these supplies to the factory's or stores accounting records. The industry standard is four hours after arrival of the supplies.[83] Order cycle time is the third management standard used by civilian industry. Order cycle time is the time expressed in days

to deliver a product to the customer on schedule as promised. Priority of the repair parts need by the customer determines this standard.[84]

Storage is the second area of emphasis in civilian industry for management of repair parts operations. There are three management standards used in the storage area of emphasis. Inventory control accuracy is the first management standard. Inventory control accuracy represents the number of repair parts on hand having no substantial difference between the dollar value of those repair parts that were inventoried, and the dollar value of the repair parts actually on hand. The civilian industry standard is one-hundred percent accuracy.[85] First pass-fill rate is the second management standard in the storage area of emphasis. First pass-fill rate is the percentage of orders from lower echelons that can be one-hundred percent filled with no back ordering. According to a leading automotive manufacturing corporation official, the industry management standard for first pass-fill rate is ninety-five percent.[86] Days of supply inventory (DOS) is the final management standard in the storage area of emphasis. DOS inventory is the total amount of a particular repair part inventory kept on hand that is available for use. One DOS or less in inventory is the leading automobile manufacturing corporation's management standard.[87]

Issue is the third area of emphasis in management of repair parts operations. The leading automobile manufacturing corporation's established management standard for issue of repair parts inventory is one day or less. Once the repair part arrives at the customer's location, the repair part is issued for use or sale immediately.[88]

Transportation is the final area of emphasis in management of repair parts operations. Civilian industry's goal for the supply and distribution system is to transport supplies from its distribution centers directly to the factory or store requesting the supplies. To accomplish this, smaller shipments that are more frequent are sent by truck and air to support OCONUS and

CONUS distribution. The objective of this system is to get the supplies to the required store or factory as fast as possible.[89] Management standards for these shipments are based on the priority of the customer's need and the OCONUS or CONUS destination. Not all repair parts orders need to be filled and shipped with the same priority. To facilitate better operations most companies have established various levels of priority service. Here is an example of a leading automobile corporation's JIT priority standards:

* *Priority One* -- emergency order from field service personnel or direct from customer. This usually indicates either down equipment or problems in new equipment installation. If this results in an order to a higher echelon, this order takes priority over others and usually has a target shipping time of twenty-four hours or less CONUS and two days or less if OCONUS.[90]

* *Priority Two* -- customer direct order for parts for non-emergency purposes. Appropriate target shipping date for this type of order frequently is two days or less if CONUS, and six days or less if OCONUS.[91]

* *Priority Three* -- intercompany orders not for immediate customer needs. This may include shipments from one zone warehouse to another for satisfying inventory stocking policies for channeling slow-moving items to other regions with higher demand. Shipping time targets for these orders is three days or less CONUS and ten days or less OCONUS.[92]

* *Priority Four* -- major field retrofits or large spare-parts orders with new equipment. These are shipped on an on a case-by-case basis, with arrival times of one to three days CONUS, and ten days OCONUS. The leading automobile corporation's order cycle time is one to three days CONUS and OCONUS ten days or less. All shipments regardless of priority have a ninety-nine percent guaranteed on time delivery rate according to its performance objective.[93]

Why the US Army has not fully implemented JIT systems and methods at tactical level focuses on the issue of the US Army and the civilian industry's performance standards and

supply system goals. These performance standards and supply system goals on repair parts supply and distribution have drawn numerous comparisons by DOD and civilian leaders as to the need for application by the US Army.[94] Comparisons between the US Army and the civilian industry repair parts supply and distribution operations focus on the areas of receipt, storage, issue and transportation of repair parts.

Civilian industry's goal for establishment of their management standards in the area of receipt, storage, issue and transportation is to maximize the corporations overall profits while minimizing costs in these areas. AR 710-2 outlines the US Army's goal for establishment of the US Army's tactical class IX supply systems management standards.

> When performance standards are set, the mission of supply support must be considered first. Thus, the capability to perform mission is sustained. Any standard set without primary regard for the mission may lead to misdirected efforts. [95]

Differences in the mission oriented goals of the US Army supply and distribution system as compared to the profit oriented civilian industry underlies the comparisons between the two organizations.

Both the civilian industry and the US Army conduct receipt operations in a similar manner. Requests or orders for repair parts are placed electronically to a central SSA or distribution center for issue of the required repair parts. If the request is not filled at this level, it passes electronically to a higher supply source. Once the supply request passes to a higher level, a management team at the civilian industry's higher distribution center or at the US Army's Division Material Management Center (DMMC) / Corps Material Management Center (CMMC) analyzes the request.[96] These activities then determine the repair parts supply availability, location and coordinate for their release to the requesting customer. Physically receiving the repair parts is also similar in both the civilian industry and the US Army supply

system.

US Army request processing time and civilian industry order processing time, are the first management standards in receipt of repair parts. Both standards measure the time frame expressed in the number of days from the time the request or order was received by the corporation's distribution center or the US Army's SSA, to the time the order was processed for shipment. Time allowed for the execution of these processes is the major difference between the US Army and the civilian industry JIT standard. The US Army SSAs allow two days for this process, while a leading automobile industry corporation JIT standard is one day or less.[97]

Process time difference allows the civilian industry to provide immediate electronic visibility to their entire supply and distribution elements necessary to fill the repair parts request. In comparison, the US Army class IX system is not even aware of the repair part requirement during this same time period. Civilian industry's process time advantage is further increased through its with JIT operations principles.

Daily civilian industry JIT repair parts supply and distribution operations use a twenty-four hour a day, seven-day a week schedule.[98] Numerous civilian corporations also include holidays and weekends.[99] Most tactical US Army supply operations take requests only Monday through Friday only unless a crisis situation has occurred. If the request arrives on a Friday afternoon or a training holiday, the work schedule for tactical US Army repair parts supply and distribution operations causes delays in process time of up to five days or longer.

Supply processing time is the second management standard in the US Army and civilian industry in the receipt area of emphasis. Supply processing time represents the time frame expressed in hours or days from the time supplies arrived at the SSA, factory or store, to posting of receipt of these supplies to the SSA's, factory's or store's accounting records. As with US Army request processing time and the civilian industry order processing time, process

time is again the key difference. The civilian automotive industry JIT standard for request processing is four hours. In the US Army, request processing standard allows up to three days. Four hour request processing time standard provides the civilian industry almost immediate visibility and use of repair parts upon their arrival. In contrast, US Army units must often wait unnecessarily to use a critical weapon system or piece of equipment while the required repair part is located in the same maintenance company SSA that is conducting the repair on the system.

OST versus customer cycle time is the third management standard in the US Army and the civilian industry. OST and customer cycle both represent the time measured in the actual days that elapse between the document date that the customer's request/order was received and processed by the SSA for a non-backordered requisition for a repair part, and the date the repair part is posted as arriving to the customer. US Army OST average in 1997 is forty days OCONUS, and ten days CONUS.[100] In contrast, order cycle time in the civilian automobile industry has four priority standards that impact the time required for this process. However, for comparison, the categories of priority one, two and three make up the majority of JIT repair parts orders.

Priority one orders has a target shipping item of twenty-four hours or less CONUS, and two days or less if OCONUS. Priority two has a target time of two days or less if CONUS and six days or less if OCONUS. Priority three shipping time targets is three days or less CONUS and ten days or less for OCONUS orders.[101]

Civilian industry's ability to receipt repair parts faster than the US Army gives them and their customers reductions in order processing time, supply processing time and OST allows the civilian industry's customers to execute repairs without extended loss in income from the inability to use the system. Second, the faster receipt process times allows corporations to

save money on inventory costs by maintaining smaller repair parts inventories on hand to meet requests. Third, and most critical to both the civilian industry and the US Army, is that higher standards by the civilian industry in the order processing time, supply processing time and OST improved customer confidence. The US Army's failure to learn this lesson is apparent as described in Scott W Conrad's book, Moving the Force, Desert Storm and Beyond:

> The Army's relatively slow delivery of repair parts by the supply system created a loss of confidence in the distribution system by combat arms units. This loss caused numerous reorders and large-scale unit hoarding of repair parts[102]

Repair parts storage is the second area of emphasis in management of repair parts by both the US Army and civilian industry in receipt of repair parts. There are three management standards for comparison between the civilian industry and the Army tactical supply system. The first comparison is between the US Army standard of inventory accuracy versus the civilian standard of inventory control accuracy. Both of these standards represent the number of repair parts on hand having no substantial difference between the dollar value of those repair parts that were inventoried and the dollar value of the repair parts actually on hand. The US Army standard is ninety-five percent accuracy while the civilian industry standard is one-hundred percent.[103] This comparison again demonstrates the civilian industry's higher standards. Depending on the amount and cost of the repair parts items stored, this five percent loss of accountability is worth millions of dollars. US Army's five percent less inventory accuracy represents repair parts reorders, excess inventory, loss of combat power from weapons systems and equipment waiting unaccounted for repair parts and expenditure of unnecessary funds on class IX repair parts.

US Army's demand satisfaction versus the civilian industry's first-pass fill rate is the second storage standard for comparison. Both standards equal the percentage of all valid

orders for repair parts that are completely filled upon request with no backordering. The US Army standard is seventy-five percent compared to a leading automobile corporation's fist-pass fill rate of ninety-five percent.[104] Civilian industry's twenty-percent higher standard further demonstrates a higher commitment and ability to meet repair parts operational requirements and customer requirements than the US Army does at tactical level. This higher storage standard provides increased customer satisfaction and creates a more flexible and responsive repair parts supply system.

Days of supply inventory (DOS) is the third storage standard. DOS represents the days of selected items of inventory kept on hand that are available for use. The leading automobile corporation's standard is one DOS or less of inventory.[105] In comparison at tactical supply level, US Army DISCOMs are authorized a combined total of ten DOS in the forward maintenance company's SSAs in the FSB, and the heavy maintenance company in the MSB.[106] US Army COSCOM GS supply companies are authorized to stock up to thirty DOS of repair parts.[107]

The civilian industry's higher standards in inventory accuracy, customer fill rates and lower on hand inventory provides numerous advantages over the US Army storage abilities. These advantages include the saving of millions of dollars from inventory reductions, while maximizing accuracy of available inventory and increased customer satisfaction from higher availability of repair parts from the suppliers.[108]

Issue, is the third area of emphasis in management of repair parts operations in both the US Army and civilian industry. There is no established policy for the US Army regarding issue of repair parts. The US Army assumes that all commanders will coordinate for issue of their repair parts as soon as they arrive at the SSA. Once the repair part arrives at the supporting SSA, it is the unit's responsibility to coordinate issue of the repair part. Some of the US Army

DISCOMs and COSCOMs have established policies that range up to three working days for issue of the repair part after its arrival at the SSA.[109] Civilian industry's established policy for issue of repair parts is one day or less. Once the repair part arrives at the store or factory, the part is issued for use or for sale.[110] This same day standard insures that repair parts supplies either are immediately transported to the SSA that supports the customer's request, or are issued for a repair the same day.

The civilian industry's ability to issue repair parts faster than the US Army provides them and their customers three distinct advantages over the US Army class IX supply system. First, a decrease in issue time allows civilian industry's customers to execute repairs in the most expeditious manner without extended loss of income from the inability to use the system. Second, the reductions in issue time allows corporations to save money on inventory costs by maintaining smaller repair parts inventories on hand to meet requests. Third, a faster issue process by the civilian industry contributes to increased customer satisfaction.

Transportation is the final area of emphasis in management of repair parts operations by both the US Army and the civilian industry. The goal of the US Army supply system is to transport repair parts from higher SSAs directly to the customer requesting units SSA. Consolidation/containerization points (CCP) are used to support OCONUS supply activities. Cargo for OCONUS DS SSAs is first directed to the CCP where the material is containerized/palletized in either vans or 463L pallets. The objective is to unitize (fill vans or 463L pallets) to the divisional main support or nondivisional DS SSA level. Consolidated shipment are then shipped to the divisional main support or the non-divisional DS SSA.[111] No standard is established by the US Army for the transportation process. Similar to the issue process, the US Army assumes that commanders will coordinate for transportation of their repair parts as soon as they arrive at the SSA. However, like the US Army's issue process at

tactical level, conflicting mission priorities, unit training holidays, and weekends cause transportation shortages.

Both the US Army class IX system and the civilian industry supply systems goal is to transport supplies from its distribution centers directly to the factory or store requesting the supplies as fast as possible.[112] However, unlike the US Army system, civilian industry uses smaller more frequent shipments by truck and air to support OCONUS and CONUS distribution. Normal civilian industry standards for these orders are three days or less CONUS and ten days or less OCONUS.[113] Additionally, all civilian shipments have a ninety-nine percent guaranteed on time delivery rate performance objective.[114] The US Army relies on commanders to decide what is a satisfactory delivery performance objective.

The ability of the civilian industry to transport repair parts more frequently than the US Army gives them and their customers four advantages over the US Army class IX supply system. First, more frequent shipments provide the repair parts to the civilian industry's customers more frequently. This allows the customers to execute repairs in the most expeditious manner without extended loss of income from inability to use the system. Second, more frequent shipments save money on inventory costs by allowing corporations to maintain smaller repair parts inventories on hand to meet requests. Third, more frequent shipments by the civilian industry generate higher customer satisfaction from receiving repair parts as soon as physically possible. Fourth, more frequent shipments provide the advantage of flexibility by allowing the civilian industry SSAs to meet changing demands by the customer.

While opinions vary between why the civilian industry and the US Army standards used at tactical level in repair parts management are so different, past attempts to integrate the two were unsuccessful. According to Lieutenant General (Ret.) Joseph Heiser, in his book A Soldier Supporting Soldiers, his attempts to adopt similar business standards to the US Army's

class IX repair parts management during the Vietnam War were met with great resistance.[115] Although limited implementation of business standards worked very well, most DOD and US Army tactical level commanders did not want these standards because it required extra management. Changes in the US Army repair parts supply and distribution system standards would necessitate greater focus on efficiency and cost, similar to those used in civilian industry. This would require, as General Heiser describes it, "for more eyeballing" of repair parts operations by US Army commanders at all levels, and an increase in their responsibility and fiscal accountability for their operations.[116] Other reasons offered to explain the difference in repair parts supply standards reflect civilian industry priorities, versus those of the US Army.

The goal of civilian JIT repair parts supply and distribution management system is to conduct operations in such a manner as to produce maximum monetary profit for the corporation.[117] In comparison, the goal of the US Army repair parts supply and distribution systems is to insure missions are sustained.[118] This "difference in focus," is the main point of contention for opponents to full-scale implementation of JIT systems and methods in the US Army at tactical level.[119] While mission focus in US Army supply operations does not always lead to efficiency or cost reduction, civilian corporations require efficient and cost effective repair parts supply systems to survive. In addition, the difference between the civilian industry and the US military repair parts supply and distribution system from 1945 until the collapse of the Soviet Union in 1991 was impacted by the threat caused by the former Soviet Union. This "Cold War" threat of the Soviet Union, helped foster a perception by US Army commanders that a well managed repair parts supply and distribution system did not support operations as easily as building massive repair parts inventories.[120] US Army commanders feared that the combination of increased JIT management requirements, higher commander accountability, and the Cold War threat would decrease combat effectiveness. However, as with General

Heiser's results from Vietnam and recent studies from RAND and the GAO have proven, these fears are incorrect.[121]

In conclusion, the civilian industry's ability to receive, store, issue, transport, and maintain less inventory, and maintain greater accuracy of repair parts supply and distribution with JIT than the US Army, provides numerous advantages. First, civilian industry's ability to receipt repair parts faster than the US Army gives them and their customers reductions in order processing time, supply processing time and OST allows the civilian industry's customers to execute repairs without extended loss of income from the inability to use the system. Faster receipt process times also allows civilian corporations to save money on inventory costs by maintaining smaller repair parts inventories on hand to meet requests. Critical to both the civilian industry and the US Army, is that higher standards by the civilian industry in the order processing time, supply processing time and OST improve customer confidence.

Second, civilian industry's JIT storage standards in inventory accuracy, customer fill rates and lower on hand inventory saves millions of dollars from inventory reductions, while maximizing accuracy of available inventory and increasing customer satisfaction from higher availability of repair parts. In comparison, the lower storage standards and abilities of the US Army at tactical level causes numerous repair parts reorders, excess inventory, loss of combat power from weapons systems and equipment waiting unaccounted for repair parts and expenditure of unnecessary funds on class IX repair parts.

Third, issue time standard improvements also help civilian industry provide the required repair parts to the necessary maintenance facility in the most expeditious manner without extended loss of income from the inability to use the system. Better issue time also allows corporations to save money on inventory costs by maintaining smaller repair parts inventories on hand to meet requests. In addition, faster issue time contributes to civilian industry's

increased customer satisfaction.

Finally, more frequent transportation shipment standards contribute to expeditious maintenance repairs. Expeditious repairs saves money on loss of income from inability to use the system, inventory costs by allowing corporations to maintain smaller repair parts inventories, while increasing flexibility to SSAs to meet changing demands by the customer. More importantly, frequent transportation shipments by civilian industry generate higher customer satisfaction by providing repair parts orders at the right place and time almost every time. As this monograph demonstrates, these improvements from JIT systems and methods in the receipt, storage, issue and transportation of repair parts could greatly enhanced class IX repair parts operations at the tactical level.

CHAPTER IV

THE "PRINCIPLED" APPROACH

The nine Principles of War (mass, objective, simplicity, unity of command, maneuver, offensive, surprise, security, and economy of force) serve as guides in the conduct and study of military operations. Not as well known however, are the nine Principles of Logistics set forth in US Army Regulation 11-8.[122] Like the nine Principles of War, the Principles of Logistics were developed as guides in the conduct and study of logistical operations. Charles Shrader in his book, United States Army Logistics 1775-1992: An Anthology, Volume One, describes the "principled approach" as a systematic method of evaluation using the Principles of Logistics to study logistical history.[123]

To measure the impact of JIT on COSCOM and DISCOM class IX repair parts operations, the author uses four of the nine Principles of Logistics to analyze Operations Desert Shield/Storm, Operation Restore Democracy and comment on the ongoing Operation Joint Endeavor. The four principles are: logistics intelligence, simplicity, timeliness and cost effectiveness. These specific principles were chosen exclusively from nine principles due to their direct impact historically on US Army tactical level and civilian industry repair parts supply and distribution operations.

The first Principle of Logistics, although there is no particular order, is logistics intelligence. US Army Regulation 11-8, describes logistics intelligence as "accurate and timely" logistics information to commanders in order to provide effective support.[124] Effective logistics intelligence is composed of two essential elements. These two elements are accurate visibility of logistics supplies during the receipt, store, and issue phases of supply and distribution, and the ability to communicate this information to all units involved in supply and distribution

operations.

Simplicity is the second Principle of Logistics. Simplicity is essential at all levels of the logistics operations to reduce confusion associated with support of complex military operations.[125] Simplicity implies that all units, but particularly logistics units, maximize available systems and assigned assets, while reducing command and control difficulties associated with support of a military operation.

Timeliness is the third Principle of Logistics. Timeliness requires logistical operations to provide support, to include supplies, in the right quantity, and at the proper time and place to accomplish military missions.[126]

Cost effectiveness is the final Principle of Logistics used in this analysis. Cost effectiveness, evaluates whether the most cost-effective means are used of the available resources to conduct logistical support operations.[127] In the summer of 1990, the US Army was able to evaluate the cost effectiveness of its logistical supply and distribution operations in sustained combat for the first time since the war in Vietnam.

On August 2, 1990 the military forces from the nation of Iraq invaded neighboring Kuwait and successfully seized control of the country within twenty-four hours. The Iraqi Army, listed, as the fourth largest in the world was equipped with 5,000 armored vehicles, 700 combat aircraft, and large stocks of SCUD missiles and artillery pieces.[128] United States President, George Bush and the United Nations (UN) Security Council immediately condemned the invasion, and passed the UN Resolution 660, which called for the Iraqis immediate withdraw from Kuwait. [129]

On 7 August 1990, after UN and US political negotiations failed to gain Iraqi withdraw from Kuwait, the US began the fastest buildup and movement of combat power, across the greatest distance in its history.[130] After six months of military buildup and training during Operation

Desert Shield, the US led coalition decided to use military force to enforce the UN Security Council resolutions. On 16 January 1991, coalition forces led by the US Air Force initiated the air campaign phase of Operation Desert Storm against Iraq. After further political negotiations failed to gain the withdrawal of the Iraqi forces from Kuwait, the US led coalition launched the ground campaign phase of combat operations on 24 February 1991. Operation Desert Storm culminated one-hundred hours later in the defeat of the Iraqi Army and the liberation of Kuwait.[131]

During Operations Desert Shield/Storm, over 12,400 tracked combat vehicles and 114,000 wheeled vehicles participated in US Army combat, combat support and combat service support operations.[132] Both operations use of large amounts of weapon systems and equipment required extensive class IX repair parts supply support. While the class IX repair parts supply support proved successful in maintaining the ground campaign, serious problems existed in resupply and accountability of repair parts.[133] According to the September 1991 General Accounting Office (GAO) Report to the US House of Representatives, had ground combat operations continued for another thirty days, repair parts supply and accountability problems could have proven costly in terms of loss of life and equipment.[134] However, to determine the actual impact on tactical class IX repair parts operations, this monograph will analyze the operations according to the four selected Principles of Logistics.

Logistics intelligence, the first Principle of Logistics requires accurate and timely logistics information to commanders on logistics supplies during the receipt, storage, issue and transportation phases of resupply operations. Asset visibility, accurate, and timely logistics intelligence on the class IX repair parts supply and distribution system was not available to US Army commanders during Operations Desert Shield /Storm.[135] As the former commander of the Army Material Command, General William Tuttle Jr. (Ret) described in his article

"Sustaining Army Combat Forces"- Part II."

> "We could get parts to the arrival port in Saudi Arabia, but there we lost visibility. We have done little to improve our distribution process since Vietnam, and we have seen similar - though not as poor-results on other occasions. We should tolerate this no longer! United Parcel Service and Federal Express can tell you precisely where your package is located in their system at any given time. Similar process could be applied to track combat essential components or even to monitor the location of entire units". [136]

Loss of accurate and timely information on class IX repair parts during Operations Desert Shield/Storm created unit uncertainty, and a loss of confidence in class IX repair parts supply system. Units no longer believed that logisticians could provide accurate or timely information on their repair parts supplies.[137] According to Scott Conrad in his book, Moving the Force, Desert Storm and Beyond, this loss of confidence in the repair parts supply system caused units to submit double requisitions on the same items.[138] Thus, units in theater began a cycle of reordering, storing excess, and trading supplies between units to make up for shortages. This self-propagating cycle bottlenecked the supply system and dramatically slowed the delivery of repair parts.

In his book The Fifth Discipline, author Peter Senge describes this phenomena as "a pattern of build up and decline in orders at each position in the supply system based on uncertainty and lack of information." He further explains that, "this pattern is further amplified when there is greater separation between the ultimate consumer and the source."[139] The US Army's separation of customer and source started with extended supply lines that ran from Germany and the United States up to distances of 8,000 miles from units during Operations Desert Shield/Storm. At the tactical level, further unit separation from their class IX repair parts supply source occurred due to the operational requirement for SSAs to support assigned units over and above doctrinal distances.[140] JIT would have translated into greater unit mobility from

more frequent and responsive transportation shipments, reductions in required repair parts inventories, reduced unit repair parts reorders from improved unit confidence in the US Army class IX supply system, improved asset visibility of units repair parts requisitions, shorter OST on repair parts supplies to units, all which would lead to an increase in potential combat power from improved operational readiness rates on weapon systems and equipment.

Logistics simplicity, the second Principle of Logistics is essential to insure maximum use of available systems and assigned assets for logistical support, while reducing difficulties associated with command and control of logistical operations. Simplicity, is essential at all levels of the logistics system to reduce the confusion associated with support of complex military operations.

Operations Desert Shield/Storm's tactical operations required highly mobile, responsive and flexible logistical support over extended tactical distances. However, as the 1991 GAO Report to the US Senate on Transportation and Distribution of Equipment and Supplies in South west Asia concluded: "the extended nondoctrinal tactical distances and shortages of transportation for class IX supply support during US Army operations in Desert Shield/Storm did cause problems in class IX repair parts supply distribution in COSCOMs and DISCOMs." [141] In an attempt to solve the transportation shortfalls, the US Army was forced to increase command and control, and operational complexity by contracting over 3,800 host nation heavy equipment transports and tractors trailers with drivers, to insure supply distributions.[142]

JIT systems and methods would have enabled COSCOM and DISCOM SSAs, to conduct much simpler and more effective methods to track, direct, and issue the right repair parts, to the right unit, at the right time. First, JIT would have improved transportation capabilities of US units by reducing the number and load space on vehicles used to carry or move excess and unaccounted for class IX repair parts. Second, JIT would have simplified command and control

of supply operations by reducing the US Army's reliance on host nation personnel to drive trucks that carried class IX supplies. Finally, JIT would have reduced COSCOMs and DISCOM SSAs required manpower and associated costs in the receipt, storage, issue and distribution repair parts, while improving accuracy and efficiency.

Timeliness of logistics, the third Principle of Logistics was a problem area in class IX repair parts management during Operations Desert Shield/Storm. COSCOMs and DISCOMs SSAs failure to provide class IX repair parts in the right quantity at the proper time limited tactical missions.[143] To resolve the class IX repair parts systems shortfalls, soldiers and commanders throughout the class IX supply and distribution system used ingenuity and personal dedication to accomplish support missions.[144]

JIT logistics accurate asset visibility of repair parts, improved distributive transportation capabilities, and higher levels of user confidence generated by the improved OSTs would have eliminated the bottleneck in the class IX repair parts supply system and significantly improved the COSCOMs and DISCOMs SSAs ability to track, direct, and issue the right class IX repair parts in a timely manner.

Cost effectiveness, the fourth Principle of Logistics requires US Army SSAs, unit commanders and soldiers to efficiently use all available systems and resources to accomplish operations. During Operations Desert Shield/Storm the COSCOMs and DISCOMs SSAs loss of supply asset visibility, units double ordering of supplies, and shortages of transportation assets led to ineffective waste and abuse of million's of dollars in class IX repair parts. According to General William Pagonis, who commanded the theater's 22nd Support Command, over 28,000 of the 41,000 supply containers shipped into theater were loaded with millions of dollars in unidentifiable loads that required to be opened at pierside upon their arrival in-country to ascertain their contents.[145] These supplies, to include class IX repair parts, were then

distributed into the COSCOMs and DISCOMs supply systems. Repair parts were wasted or were commandeered by other units without receiving proper accountability of receipt from SSAs.[146]

Excessive costs were also incurred in units by allocating unresourced funds to purchase personal computers, facsimiles, and repair parts from the civilian market due to the US Army's ineffective asset visibility systems. Unauthorized uses of manpower (liaisons) were also used to make up for class IX supply systems failures to monitor units requisitions in US Army SSAs in COSCOMs and DISCOMs. Liaison soldiers responsibility was to physically count, search and report unit repair parts statutes, and to resolve class IX repair parts supply and distribution problems.[147] While these non-standard techniques and the use of excess funds did meet the minimum tactical requirements during Operations Desert Shield/Storm, the costs associated with nonauthorized liaisons, excess repair parts inventories and, extensive contracting non-military transportation were not required or efficient.

By having JIT systems and principles during Operations Desert Shield/Desert Storm, the US Army would have realized both significant savings and efficiency in the receipt, storage, issue and transportation of class IX repair parts. First, JIT class IX repair parts operations would have saved millions of dollars on inventory costs by maintaining smaller repair parts inventories, and faster more frequent repair parts receipt and issue times to supported units. Second, and most critical to US Army commanders, higher JIT customer confidence would have provided cost avoidance savings from reductions in unit reordering class IX repair parts. Third, JIT improvements in inventory accuracy, and more frequent and flexible JIT repair parts transportation shipments would have saved millions of dollars in class IX repair parts inventory reductions, while maximizing accuracy of available inventory. Finally, using JIT systems and methods in transportation operations would have reduced contracting costs for host nation

drivers and vehicles to assist in class IX supply operations. Unfortunately, the problems from lack of JIT systems and methods in the receipt, storage, issue and transportation of class IX repair parts operations at tactical level surfaced again during Operation Restore Democracy.

In December 1990, the country of Haiti selected Jean-Betrand Aristide as its first democratically elected president. Aristide, was a populist Catholic priest whose followers came from the mostly poor communities. Aristide had trouble in government from the beginning-in part because members of the Haitian military and the economic elite within the country openly resisted him. In September 1991, he was ousted by a military coup and forced into exile in the United States.[148]

Immediately after the coup, the UN reacted by placing a binding resolution imposing an embargo aimed at encouraging the coup leader Lieutenant General Raol Cedras, commander of the Forces Armees d' Haiti to return control of the country back to the Aristide elected government. In July 1993 representatives of the Aristide government and the Haitian military met with US and UN mediators at Governors Island New York, and reached an agreement that would allow Cedras to step down and return Aristide to power by October 1993.

On October 11, 1993 in an attempt to begin implementation of this agreement, the USS Harlan County tried to bring an advanced party of the UN contingent as agreed upon under the Governors Island Accord. Upon arrival, the ship was met by an angry group of armed demonstrators who turned the ship away from landing. On October 13, the UN Security Council voted to reinpose economic sanctions against Haiti.[149]

By early spring 1994, the US Defense Department began to prepare possible military scenarios to resolve this crisis. In accordance with these actions, US President Bill Clinton began a more aggressive effort to restore Aristide to include a total embargo of Haiti and possible use of military force to remove the Cedras regime. By May 1994, the UN Security

Council passed a resolution, which demanded immediate resignation of Cedras and threatened the use of hostile military actions. In response, the US military began to develop Operation Plan 2370 to forcibly remove the Haitian military and establish a secure environment for Aristide's return.[150]

In July 1994, the US military began development of a second plan, Operation Plan 2380 that called for the permissive entry into Haiti. This plan allowed for a peaceful removal of the Cedras regime and return of the Aristede Government to power. By 13 September 1994 after continued political negotiations failed to secure a peaceful settlement, the US military began to deploy from Norfolk Virginia aboard the aircraft carriers USS America and USS Dwight D. Eisenhower to Haiti with intent to forcibly remove Cedras's regime from power.

On 16 September 1994, President Clinton sent former President Jimmy Carter, Senator Sam Nunn and former Chairman of The Joint Chiefs of Staff, General Colin Powell to negotiate a peaceful resolution in order to avoid a military invasion. While the invasion forces from the US XVIII Airborne Corps were enroute from Ft. Bragg on 18 September for the invasion, Cedras agreed to a peaceful settlement. Following his agreement on 19 September, military forces from the US Army's 10th Mountain Division entered Port-au Prince without resistance and began Operation Uphold Democracy. Limited violence occurred during the following weeks but quickly subsided as US forces occupied the country.[151]

Immediately, US forces in country began the process of preparing for the return of the Aristide government and assisted the interim government in reopening its economy and rebuilding its infrastructure. On October 15, President Aristide arrived back in country. This began the reduction in US forces in country and handover of the command of this operation to the UN in January 1995.[152]

Operation Restore Democracy from the period of 19 September 1994 through January

1995, had over 5,000 tracked and wheeled vehicles, and equipment to sustain operation for the US soldiers participating in military operations.[153] Operation Uphold Democracy included over 20,000 service members and their assigned weapons and equipment from all services as well as twenty-four other nations.[154] This contingent required extensive services and supplies including class IX repair parts due to Haiti's poor infrastructure, limited economy and geographic separation from the US and other nations. The 1st COSCOM and the 10th Mountain Division DISCOM provided all tactical level class IX repair parts support to US Army forces on the island. While both 1st COSCOM and 10th Mountain DISCOM class IX repair parts supply and distribution operations proved successful in maintaining the operations during this period, serious problems existed in resupply and accountability of repair parts. According to Center for Army Lessons Learned (CALL) reports from units in country at the time, personnel interviews with soldiers in the 1st COSCOM Material Management Center (CMMC), which was responsible for management of repair parts requisition in theater, and from the authors own observations, repair parts supply and accountability problems caused serious delays in mission accomplishment.[155]

Accurate and timely logistics intelligence, the first Principle of Logistics was a problem to US Army commanders on class IX repair parts supply status during receipt, storage, issue and transportation operations. As described by one of the senior officers responsible for the management of supply operations during Operation Restore Democracy.

> " We had more repair parts in country than anyone knew about! Without someone personally going down and physically opening connexes at the corps SSA, and searching the warehouse where the repair parts were supposed to be accounted for, most units would not have received any of their requisitioned repair parts. From what I and my assigned NCOs working with me who had also worked in COSCOMs and DISCOM SSAs in units deployed during Desert Storm told me, the problems I witnessed in accountability, storage and issue of repair parts had not changed since Operations Desert Shield/Storm. In fact, the majority of NCOs in CMMC thought that the operations in

> Haiti were even worse than what they had seen during Operations Desert Shield/Storm. The only difference was Restore Democracy was smaller in comparison due to less equipment and soldiers deployed." [156]

Loss of accurate and timely information on class IX repair parts during Operation Restore Democracy created a loss of confidence in the class IX repair parts supply system. Units no longer believed that logisticians could provide accurate or timely information on their repair parts supplies.[157] Instead of waiting for the repair parts supply system to fill their requisitions, units went around it. Units made phone calls directly back to the US or sent soldiers to the Dominican Republic or Miami to purchase repair parts not readily available in country or with long supply lead times.[158]

Like Operations Desert Storm/Shield, lack of confidence in the repair parts supply system led to units double ordering repair parts, storing excess and trading supplies with other units to make up for shortages. Additionally, the US Army was again faced with extended lines of supply from customer and source that extended up to distances of 2,000 miles from units during this operation. At the tactical level, geography, poor infrastructure, and limitations on operational conditions for supply convoys increased unit separation problems from their class IX repair parts supply source.[159]

Full implementation of JIT systems and methods at tactical level during Operation Restore Democracy would have improved the 1st COSCOM and 10th Mountain DISCOMs SSA class IX repair parts operations. JIT would have reduced SSAs and unit repair parts inventories, improved asset visibility of units repair parts requisitions, and lowered unit repair parts reorders by improving unit confidence in the US Army class IX supply system. JIT improvements would have led to an increase in potential combat power from improved operational readiness rates on weapon systems and equipment.

The second Principle of Logistics, simplicity, was required to support class IX repair part management during Operation Restore Democracy. The combination of poor infrastructure and limited host nation assets required highly mobile, responsive and flexible logistical support over geographically separated distances.[160] Without the use of individual soldiers' initiative and extensive reliance on complex non-habitual support methods such as local contracting and telephone calls to CONUS units, problems that are more significant could have occurred.

JIT systems and methods in the 1st COSCOM and 10th Mountain DISCOM SSAs would have allowed the conduct of much simpler and more effective methods to track, direct, and issue the right repair parts, to the right unit, at the right time. First, JIT would have improved transportation capabilities of US units by reducing the number and load space on vehicles used to carry or move excess and unaccounted for class IX repair parts. Second, JIT would have simplified 1st COSCOM and 10th DISCOMs SSAs required manpower to conduct the receipt, storage, issue and distribution repair parts, while improving accuracy and efficiency to the customer. Finally, JIT would have reduced the command and control problem of sending soldiers outside of the country to purchase repair parts that were not accounted for in the system.

Timeliness of logistics, the third Principle of Logistics, was also a problem in class IX repair parts management during Operation Restore Democracy. Both 1st COSCOM and the 10th Mountain DISCOM SSAs failed to provide class IX repair parts in the right quantity and at the proper time and place to accomplish tactical missions.[161] To overcome these problems, units used local purchases, traded repair parts with other units, or coordinated telephonically back to their parent unit in the US to coordinate special shipments to improve timeliness of repair parts supplies[162] JIT's accurate asset visibility of repair parts, more frequent and flexible transportation capabilities, and higher levels of user confidence from improved OSTs would

have eliminated the bottleneck in the class IX repair parts supply system. JIT would also improve the 1st COSCOM and 10th DISCOMs SSAs timeliness by accurate tracking, efficient distribution of transportation assets, and faster issue of the right class IX repair parts, to the right units at the right time.

The final Principle of Logistics used in this analysis is cost effectiveness. Cost effectiveness during Operation Restore Democracy required US Army SSAs, unit commanders and soldiers to efficiently use all available systems and resources in accomplishment of operations. During Operations Restore Democracy the 1st COSCOM and 10th DISCOMs SSAs loss of supply asset visibility, units double ordering of supplies, and shortages of transportation assets caused problems in the issue, storage and receipt of class IX repair parts. According to numerous interviews with soldiers assigned to the 1st COSCOM CMMC, and the authors own personal observations during the first forty days of Operation Restore Democracy, millions of dollars in unidentifiable connexes filled with class IX repair parts required manual opening to verify their contents upon their arrival in-country. These unaccounted for class IX repair parts were later distributed into the 1st COSCOM and 10th Mountain DISCOM's supply systems. There they were wasted or hoarded without receiving proper accountability of receipt from these SSAs.[163] Class IX repair parts funds were also spent by many units to purchase personal computers, facsimiles, and repair parts due to unavailability or because the current automated supply systems failed to support efficient supply and distribution operations. As in Desert Shield/Storm, non-standard techniques and higher expenditures of funds did meet the minimum tactical requirements during Operation Restore Democracy. However, the cost in terms of soldiers, excess repair parts inventories and, use of money to local purchase critical repair parts that were not available were all unnecessary expenses if JIT systems and methods were available.

By using JIT technology systems and principles, the 1st COSCOM and 10th DISCOM SSAs and their supported units would have realized significant savings in class IX inventory levels, local purchase costs and personnel expenditures. Instead, the US Army again failed to take advantage of readily available JIT systems and procedures. Since Operation Restore Democracy, the US Army has made progress at operational and strategic level to transport and provide asset visibility for class IX repair parts.[164] However, as recent reports from Operation Joint Endeavor show, the US Army still has not made changes to resolve the systemic class IX repair parts supply and distribution problems that have continued to plague US Army tactical operations since World War II.[165]

CHAPTER V

CONCLUSIONS AND SUGGESTIONS

> "By 2010, the US Army will be "knowledge based," and that will give it a "distinct advantage" over any competitor. That knowledge will come via computers and satellites in the form of digital data about friendly and enemy positions and assets-all in real time".[166]
>
> Maj Gen. Robert Scales, deputy chief of staff for doctrine at the Army Training and Doctrine Command, September 1997.

Future US Army military operations will use new weapons systems and equipment that have highly integrated parts that use computers and other complex electronic and electro-optical equipment.[167] Current weapons systems such as the MI tank, M2 infantry fighting vehicle, Apache helicopter and the multiple launcher rocket system (MLRS) already require a highly integrated, responsive maintenance and repair parts supply and distribution systems to sustain their operations.[168] This monograph clearly demonstrates that the current US Army class IX repair parts system cannot continue to support these highly complex weapons systems in a cost efficient manner. As the 1988 RAND study on "Evaluating the Combat Payoff of Alternative Logistics Structure for High-Technology Subsystems" pointed out:

> "The Army's investment in high tech weapons systems may be undermined if the logistics structure cannot ensure their battlefield availability." [169]

Given the requirement for a wider range of potential military operations in uncertain environmental conditions, the US Army COSCOMs and DISCOMs must provide more timely, accountable, and cost-efficient class IX repair parts supply operations, using fewer personnel. Since 1985, the US Army's military budget when compared to 1995, has declined twenty-four percent from 82.3 billion to 62.7 billion dollars, while operations requiring repair parts has

increased 300 percent.[170] These complex budget and operations problems require "new methods and systems" to improve class IX repair parts supply and distribution. Without new methods and systems, the class IX repair parts supply and distribution system will severely limit the capabilities of the new technologically advanced US Army weapons systems and equipment.

This monograph's analysis of Operations Desert Shield/Storm, Uphold Democracy, and reports from class IX repair parts operations in Operation Joint Endeavor, combined with the analysis of the current civilian industry repair parts supply and distribution operations show two key points. First, these operations demonstrate that COSCOMs and DISCOMs current tactical class IX supply and distribution systems require change. Second, the monograph proves that JIT systems and methods are effective, efficient and available to the US Army.

This author recommends the US Army implement JIT logistics systems and methods in the COSCOMs and DISCOMs to resolve the US Army's current class IX repair parts supply problems at corps and divisional level. However, as Lieutenant General (Ret) Joseph Heiser pointed out in his book, A Soldier Supporting Soldiers, the US Army problems of timeliness, accountability, and cost effectiveness in class IX repair parts supply and distribution operations have occurred since World War II.[171] Further, past attempts to adapt more civilian business like JIT standards and procedures, while demonstrating initial success, have met with resistance by tactical level commanders.[172] With command support, JIT systems and principles hold the potential to resolve the past class IX repair parts timeliness, accountability, and cost effectiveness problems.

The problems of timeliness, accountability, and cost effectiveness in the class IX repair parts supply and distribution system remain unresolved. Early lessons learned and unit comments out of Operation Joint Endeavor in Bosnia still report serious problems in timeliness

and accountability of the class IX repair parts supply and distribution system.[173] JIT systems and principles fully integrated into US Army corps and divisions class IX repair parts supply system would ensure repair parts for these high tech systems are available in a timely manner to sustain battlefield availability. JIT's accurate and timely logistics information provides the most cost effective means to provide class IX repair parts in the right quantity, and at the proper time and place, while maximizing use of equipment and people. Changes such as JIT systems and methods in organizations like the US Army are never easy. However, the potential JIT benefits, compared to the risk of the US Army's current system is worth the effort. As described in Stephan Rosen's book, Winning the Next War: Innovation and the Modern Military, "organizational and systems changes in armies can produce revolutionary changes in warfare."[174] The monograph author recommends two JIT changes to the current class IX repair parts system and organizational structure in COSCOMs and DISCOMs.

Changes to the organizational structures and missions of the COSCOM GS repair parts supply company and the DISCOM light maintenance company, are the first recommended changes in the COSCOM and DISCOM class IX supply and distribution systems. As described in FM 63-3, Corps Support Command and FM 63-21 Main Support Battalion, the responsibility of the GS repair parts supply companies and the MSB light maintenance companies are to receive, store and issue class IX repair parts as they arrive in the corps or the division.[175] Then, using assigned company transportation, host nation or other dedicated US truck assets, the companies' transport these repair parts supplies down to other direct support (DS) maintenance units in the divisions and corps.[176] This system of excess storage and double handling and transportation of repair parts shipments is no longer required with implementation of JIT principles and systems.

The first organizational structure and mission change is to eliminate or reduce the

COSCOMs GS supply companies repair parts storage mission and personnel structure. The eliminated authorized class IX repair parts stockage from the GS repair parts supply companies' is then added to the DISCOMs light maintenance companies' and COSCOMs nondivisional maintenance companies' stockage. Other changes in the COSCOMs' and DISCOMs' organizational structures and missions are to add additional transportation assets. DISCOM's additions include adding a second Transportation Motor Transport Company to the DISCOM's organizational structure, and the addition of enough transportation assets to the organizational structure in the DISCOM's light maintenance companies to move one-hundred percent, versus the current fifty percent of the companies assigned equipment, personnel and class IX repair parts stockage in one move.[177] COSCOMs additions are to add enough transportation assets to the nondivisional maintenance companies and the GS repair parts supply company organizational structure to move one-hundred percent of the companies assigned equipment, personnel and assigned class IX repair parts stockage. The nondivisional maintenance companies mobility is fifty percent.[178] The GS repair parts companies mobility is fifty percent.[179] Changes in structures and missions will enable the COSCOMs and DISCOMs light maintenance companies' direct class IX repair parts supply and distribution to their supported units, and will allow for smaller and more frequent distributions of unit repair parts. All of these changes will save costs in personnel, equipment, inventory and OST, while improving unit confidence in the class IX repair parts supply system.

Methods of repair parts supply and distribution is the last recommended change in the COSCOMs and DISCOMs repair parts supply system. As clearly shown during the monograph's comparison of the US Army and civilian industry standards for receipt, storage, issue and transportation of repair parts, the comparable current US Army's standards are consistently lower and more expensive. In concert with the recommended changes in

organizational structure and mission, new higher JIT standards will enable the US Army COSCOMs and DISCOMs to be more responsive, flexible, and cost effective during class IX repair parts supply and distribution operations. Additionally, these new JIT standards create an environment that insures all US Army leaders and soldiers are committed and accountable to support these standard changes.

This monograph began with the thesis question of: Can implementation of Total Asset Visibility and Just-in-Time Logistics technology in class IX operations dramatically improve the COSCOMs and DISCOMs ability to receive, store, and distribute class IX repair parts to its supported units? The answer to this thesis question can be yes or no. The first answer to this thesis question is yes it can. Given the wide range of potential military operations in uncertain environments, JIT improvement provide the asset visibility, flexibility and cost effectiveness needed to support future class IX repair parts supply and distribution. However, without vision and total support by the US Army leadership, JIT systems and methods even if implemented will not dramatically improve the COSCOMs and DISCOMs class IX repair parts operations.

ENDNOTES

[1]. Kaminski, Paul G. "The Revolution in Defense Logistics." The Keynote Address of the Under Secretary of Defense for Acquisition and Technology at the 12th National Logistics Symposium and Exhibition. Alexandria, Virginia. 31 Oct. 1995. p 1.

[2]. Pagonis, William G. Moving Mountains. Boston: Harvard Business School Press, 1992. p 1, 2.

[3]. McDuffie, John M. "Force XXI Corps Support" Logistics: Desert Storm and Into the 21st Century. Command and General Staff College, Department of Logistics and Resource Operations (DLRO) Reference Text. Fort Leavenworth KS. 1996. p 184,185; Roach Franklin D. "Personal Notes." Here after referred to as the author of this monograph. Author was assigned as part of the 1st COSCOM G3 Forward Support Operations Team that Deployed in support of Operation Restore Democracy. Author was one of team responsible to compile the information for this article and to extrapolate the data for the news brief used by BG McDuffie.

[4]. Peppers, Jerome G. History of United States Military Logistics: 1935 -1985. Huntsville, AL: Logistics Education Foundation Publishing, 1988. p 80-81,112,113. In these pages, the author discusses the distribution of supplies to the forces during World War II. He describes the concept of "block loading" supplies. This concept was to prepare and package a preconfigured set of supplies and materials that would be needed by one thousand men for twenty days at first, and then thirty days later. These supplies would be shipped to the theater and then distributed down through a series of supply units from the army's down through division's supply systems. On page 112-113, he further expands the issue of stockpiling during World War II, by the US Army supply system. In these pages, he addresses the US Army's use of a "push" supply system. This system automatically shipped supplies to units without requisitioning them. Both systems created excess and caused decreased efficiency in supporting the combat units. These systems were put in place to increase supply efficiency to the combat units in an attempt to compensate for the movement, storage, distribution and transportation problems in theaters; Director of the Service, Supply, and Procurement Division, War Department General Staff. Logistics of World War II. Washington, DC: Government Printing Office, 1947. p 169; and the Joint Chiefs of Staff, Historical Division, Movement Control in Three Wars: World War II, Korea, Vietnam, Washington, DC: Joint Chiefs of Staff, March 1973 quoted in Lieutenant Colonel David C. Rutenberg, USAF, The Logistics of Waging War, American Logistics 1774-1985 Emphasizing the Development of Airpower.

[5]. FM 100-10, War Department Field Manual, Field Service Regulations and Administrations. United States Printing Office, Washington, DC. 15 November 1943, p 62.

[6]. Van Creveld, Martin. Supplying War. New York: Cambridge University Press 1977. p 5,6. On these pages the author references units within the (Communication Zone) COMZ that suffered supply shortages on the front lines while reserves of these stocks were available in the rear of the COMZ in the European Theater during August and September 1944.

[7]. Herson, James Jr. "Operation Joint Endeavor: Container Operations." Transportation Corps Professional Bulletin (Summer 97). p 18.

[8]. Berman, Mortan B., Douglas W. McIver, Marc W. Robbins and John F. Schank. Evaluating the Combat Payoff of Alternative Logistics Structures for High-Technology Subsystems. The RAND Corporation R-3673, Santa Monica: CA, October 1988. p 1.

[9]. General Accounting Office, GAO Report: Defense Transportation Commercial Practices Offer Improvement Opportunities United States General Accounting Office (Washington, D.C.: GPO, 26 Nov, 93). p 3, 4.

[10]. Mahan, Charles S. "Power Projection Logistics." The Director for Army Supply and Logistics briefing to the Command and General Staff Course. Fort Leavenworth, Kansas. 17 April 1997. p 3, 4. This brief was given to the Command and General Staff College to provide the current state and future issues for logistics in the Army. On pages 3, 4 of the briefing slides Major General Mahan discussed the declining DOD and Army budget, and its negative impact on all supply issues to including class IX repair parts. In particular to class IX repair parts, he discussed the increasing financial costs associated with maintaining soldiers on active duty to handle the receipt, store and issue of repair parts.

[11]. Kaminski, Paul G. "The Revolution in Defense Logistics." p 2.

[12]. Berman, Mortan B., Douglas W. McIver, Marc W. Robbins and John F. Schank. Evaluating the Combat Payoff of Alternative Logistics Structures for High-Technology Subsystems. p 1, 2, 3.

[13]. Heiser, Joseph M. A Soldier Supporting Soldiers. Washington, DC: US Army Center for Military History, 1991. p 54.

[14]. Drummand, John, Rick, Eden, and John Folkeson. Weapon System Sustainment Management: A Concept for Revolutionizing the Army Logistics System. The RAND Corporation, Santa Monica: CA, October 1994. p V. In this executive summary of the report, the authors stress the need for the Army to change its current logistics system. Further, they stress that a combination of factors to include: a leaner defense budget, a shift from the static European Theater War scenario, and an increase in US based rapid response operations require a fundamental change to the current US logistics system.

[15]. Quoted in "US Military and Peacekeeping Operations," in Peace Support Operations and the US Military, Barry R. McCaffery, ed. Dennis J. Quinn, Washington D.C.: Institute for National Strategic Studies, National Defense University, 1994. p 3.

[16]. Komarow, Steven. "GAO report: Pentagon keeps buying unneeded supplies" USA Today 28 Feb. 1997, sec. A07. The author uses the General Accounting Office (GAO) report to cite examples of excess repair parts being maintained throughout the DOD supply system. The GAO, which conducts audits for Congress, portrayed a military purchasing system that fails to correct errors and inefficiencies. Therefore, 3.3 million items, ranging from circuit boards to gaskets, about 1.5 million dollars were in excess supply or were no longer needed at all. "More than half the Pentagon's 70 billion dollar reserve of spare parts and supplies is unneeded surplus, yet the military is buying more items it doesn't need," the GAO commented. Much of the inventory has no projected demands, and it is unlikely this inventory will ever be used concluded the GAO report.

[17]. Narus, James A, and James C Anderson. "Rethinking Distribution: Adaptive Channels" Harvard Business Review. Jul/Aug 1996: p 112-118. In this article, the authors discuss the ways distribution channels are becoming more flexible and responsive. To support this argument the authors conducted an extensive research study in 1994 and 1995. They identified progressive manufacturers and distributors through discussions with colleagues, with managers from a variety of industries-including information technology and integrated logistics-and with the executive presidents of two distributor trade associations. They then conducted a series of individual field interviews in the United States and Europe with sixty-two managers from twenty-seven US, European, and Japanese organizations that are considered to be leaders in distribution.

Traditional distribution channels try to meet those challenges by forcing the manufacturer and its distributors to stock excess inventory or hire surplus personnel. Recognizing the costliness of this approach, innovative managers are experimenting with various kinds of auxiliary support systems. Such systems allow a manufacturer and its distributors to respond to extraordinary situations by sharing inventories and support services in return for prespecified remuneration. What makes the systems possible is information technology and integrated logistics systems that can monitor the availability of products and services, process orders, and deliver products and services rapidly from distant locations to customers' sites.

An example cited is Volvo GM Heavy Truck Corporation and its dealers solved a vexing business problem. Volvo GM sells commercial trucks and repair parts in the United States through a channel that includes regional warehouses and commercial truck dealers. Between 1993 and 1995, the company's dealers had been reporting more and more stockouts on critical parts, even though inventory levels were soaring. Because they could not provide consistent, timely repairs, the dealers were losing a considerable amount of business. By developing shared information systems and integrated logistics systems redundant pools of inventory and duplicate service operations were pared back, costs fell, and less business was lost because of stock-outs and the inability to respond to emergencies. More recent developments in shared information systems and integrated logistics systems, include the emergence of highly competent transportation carriers such as Federal Express linking up with suppliers like General Motors. Finally, as redundant pools of inventory and duplicate service operations are pared back, costs fall, often by fifteen to twenty percent. At the same time, the amount of business lost because of stockouts and the inability to respond to emergencies drops, sometimes by as much as fifty to seventy-five percent. This heightens customer satisfaction by augmenting their own capabilities with those of partners that are more proficient.

[18]. Kaminski, Paul G. "The Revolution in Defense Logistics." p 2; Narus, James A, and James C Anderson. "Rethinking Distribution: Adaptive channels" Harvard Business Review. Jul/Aug 1996: p 112-118; Prokesch, Steven "Making Global Connections at Caterpillar." Harvard Business Review. Mar/Apr 1996: p 88-90. In this article the author describes some of Caterpillar Corporations current and future logistic changes and their impact on the corporation

[19]. Johnson, Nancy (Director Joint Total Asset Visibility (JTAV) Office), "Defense Total Asset Visibility Implementation Plan", 23 May 1996: http://www.acq.osd.mil/log/mdm/tav/index.htm. 4 Sept. 1997: p iii

[20]. Greene, James H. Production and Inventory Control Handbook. 2nd ed. New York: McGraw - Hill Book Company, 1987: p 24.10.

[21]. Kaminski, Paul G. "The Revolution in Defense Logistics." p 3.

[22]. US Army Regulation 11-8, Principles and Policies of the Army Logistics System. Washington, D.C.: Department of the Army, 18 March 1976, chap 3. The nine principles are listed below.

LOGISTICS INTELLIGENCE: Commanders must have accurate and timely logistics information in order to provide effective support
OBJECTIVE: Logistic endeavors must be directed toward a clear and attainable objective.
GENERATIVE LOGISTICS: The professional application of initiative, knowledge, and ingenuity and the innovative exploration of technical and scientific advances are fundamental to the generation of logistics improvements.
INTERDEPENDENCE: Logistic system efficiency requires effective interrelationship among parts of the system.
SIMPLICITY: Simplicity is essential at all levels of the logistics system.
TIMELINESS: Logistics support must be provided in the right quantity and at the proper time and place for accomplishment
IMPETUS: The impetus of logistics support is forward to support the combat mission.
COST EFFECTIVENESS: Efficient management of Logistics resources is essential to cost-effective logistic support.
SECURITY: Security of every facet of the logistics system must be maintained to preserve resources and assure sustained combat capability.

[23]. Heiser, Joseph M. A Soldier Supporting Soldiers. Washington, DC: US Army Center for Military History, 1991. p 151.

[24]. Logistics in World War II, Final Report of the Armed Services Forces. Washington, DC: Center of Military History. United States Army, 1993. p 25-27, p 57.

[25]. Herson, James Jr. "Operation Joint Endeavor: Container Operations." Transportation Corps Professional Bulletin (Summer 97). p 18.

[26]. Logistics in World War II, Final Report of the Armed Services Forces. p 25-27, p 57.

[27]. ibid. p 88.

[28]. FM 100-10, War Department Field Manual, Field Service Regulations and Administrations. United States Printing Office, Washington, DC: 15 November 1943. p 2, and Huston, James A. The Sinews of War. Washington, DC: United States Army Center of Military History, 1988. p 493.

[29]. ibid. p 2.

[30]. ibid. p 91.

[31]. FM 100-5, War Department Field Manual, Quartermaster Field Manual, Quartermaster Operations. United States Printing Office, Washington, DC: April 29, 1943. p 100.

[32]. FM 101-10 War Department Field Manual, Staff Officers Field Manual, Organization, Technical and Logistical Data. United States Printing Office, Washington, DC: December 21, 1944. p 151, 158 chapter 1.

[33]. FM 100-5, War Department Field Manual, Quartermaster Field Manual, Quartermaster Operations. p 104.

[34]. ibid. p104.

[35]. Bibliography of Repair Parts Studies 1956 - Present. US Army Logistics Center. Fort Lee, Virginia. 1975. This bibliography provides an executive summary of all the studies conducted by DOD, GAO and contracted agencies for the DOD.

[36]. Heiser, Joseph M. A Soldier Supporting Soldiers. p 129, 130.

[37]. Report by the Department of the Army Board of Inquiry on the Army Logistics System, Volume VI. United States Printing Office, Washington DC: January 1967. p III-6, 7.

[38]. ibid. p III 6-7.

[39]. US Army. FM 63-3, Corps Support Command. Washington DC: Department of the Army, 30 September, 1993. p 1-1, 1-10, 1-17.

[40]. ibid. p 1-18, 19. Figure 1-6,1-7.

[41]. US Army. FM 100-10, Combat Service Support. Washington, DC: Department of the Army, 1994. Annex A1. This annex lists the classes of supply to include class IX repair parts.

[42]. FM 100-10, War Department Field Manual, Field Service Regulations and Administrations. United States Printing Office, Washington, DC: 1940. p 18.

[43]. Rutenberg, David C., and Jane S. Allen. The Logistics of Waging War. Gunter Air Force Station, Al. Air Force Management Center, 1983. p 121.

[44]. ibid. p 121.

[45]. ibid. p 121.

[46]. Peppers, Jerome G. History of United States Military Logistics: 1935-1985. Huntsville, Al: Logistics Education Foundation Publishing, 1988. p 113.

[47]. Logistics in World War II, Final Report of the Armed Service Forces. p 57.

[48]. Ruppenthal, Ronald G. Logistical Support of the Armies. Volume II, Washington, DC: United States Army Center of Military History, 1959. p 215, 216.

[49]. Herson, James Jr. "Operation Joint Endeavor: Container Operations." p 18.

[50]. Bibliography of Repair Parts Studies 1956 - Present.

[51]. US Army FM 100-10, Combat Service Support. Washington, DC: Department of the Army, 1995. Annex A3, B3, C 6,7.

[52]. US Army FM 63-3, Corps Support Command. p 1-18, 19. Figure 1-6, 1-7.

[53]. Kullman, Brian C. and Robert W. Haessler, Kaban, American Style, "Annual Proceeding of the NCPDM (1984), p 101. quoted in James C. Johnson and Donald R. Wood. Contemporary Logistics. New York, MacMillian Publishing Company, 1990. p 237.

[54]. Schoneberger, Richard J. Japanese Manufacturing Techniques. New York, MacMillian Publishing Company, 1982. p 214.

[55]. Heiser, Joseph M. A Soldier Supporting Soldiers. p 97.

[56]. Schoneberger, Richard J. Japanese Manufacturing Techniques.

[57]. Johnson, James C. and Donald R. Wood. Contemporary Logistics, New York, MacMillian Publishing Company, 1990. p 237.

[58]. Ohno, Taiichi, Toyota Production Systems: Beyond Large-Scale Production, Cambridge, Massachusetts. Productivity Press, 1988. p 1.

[59]. ibid. p 1.

[60]. Lieb, Robert C. and Robert A. Millen. "The Responses of General Commodity Carriers to Just-In-Time Manufacturing Programs." Transportation Journal (Volume 30 #1). p 6. In this article the authors discuss the results of their study. Based on this survey of trucking companies who service JIT manufacturer's, it seems to show that the largest percentage of manufacturers began using JIT principles in the late 1980s with up to eighty percent using JIT by 1990.

[61]. Kaminski, Paul G. "The Revolution of Defense Logistics." The keynote address of the Under Secretary of Defense for Acquisition and Technology at the 12th National Logistics Symposium and Exhibition. Alexandria, Virginia. 31 Oct. 1995. p 2, 3.

[62]. ibid. p 2, 3.

[63]. Narus, James A. and James C. Anderson. "Rethinking Distribution: Adaptive Channels" Harvard Business Review Jul/Aug. 1996. p 114 - 115.

[64]. Ehrlich, Eugene. Websters Dictionary, Collins Gem New Edition, New York: Harper Collins Pub, 1990. p 521.

[65]. Kaminski, Paul G. "The Revolution in Defense Logistics." The Keynote Address of the Under Secretary of Defense for Acquisition and Technology at the 12th National Logistics Symposium and Exhibition. Alexandria , Virginia. 31 Oct. 1995. p 1-4.

[66]. US Army Regulation. 710-2, Inventory Management Policy Below Wholesale Level. Washington, DC: Department of the Army, 1994. p i -166.

[67]. US Army Regulation. 710-2, Inventory Management Policy Below Wholesale Level . p 41.

[68]. ibid. p 43.

[69]. ibid. p 8.

[70]. ibid. p 8.

[71]. ibid. p 56.

[72]. Information from the Combined Arms Support Command unit logistics status web page. Information obtained 29 October 1997, at http://www.almc.army.mil/organization/alog/alog.htm

[73]. Hinton, Donald H. " A Customers Perspective on Army Material Distribution" Army Logistician, Ft Lee Virginia. Jan-Feb 1995. p 10-11.

[74]. US Army Regulation. 710-2, Inventory Management Policy Below Wholesale Level. p 45 and p 53.

[75]. ibid. p 53.

[76]. ibid. p 37.

[77]. Authors own note filed from personal experience working as Company Commander of and Forward Support Bn SSA in the Second Infantry Division 1991-1993, and as Chief of Maintenance and Class IX Repair Parts Operations for the 1st COSCOM Support Operations Section from 1993-1994.

[78]. US Army Regulation. 710-2, Inventory Management Policy Below Wholesale Level. p 44.

[79]. Telephone interviews conducted on 14 and 18 November 97. Interview conducted with a leading automobile manufacturing corporation official. His responsibilities include management of automotive assembly materials and repair parts distribution for their corporations midwest assembly plant and automobile sales dealers in the state of Kansas and Missouri. The monograph author agreed not to publish this persons name or his employer in the monograph or notes due to industry proprietary concerns.

[80]. Telephone interviews conducted on 14 and 18 November 97 with a leading automobile manufacturing corporation official.

[81]. ibid.

[82]. ibid.

[83]. ibid.

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[85]. ibid.

[86]. ibid.

[87]. ibid.

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[89]. ibid.

[90]. ibid.

[91]. ibid.

[92]. ibid.

[93]. ibid.

[94]. Pagonis, William G. Moving Mountains. Boston: Harvard Business School Press, 1992. p 211-214. and Medows, Sandra I. "Overnight Combat Supply Delivery Not Unthinkable." National Defense. December 1995. p 11. and Kaminski, Paul G. "The Revolution in Defense Logistics." The Keynote Address of the Under Secretary of Defense for Acquisition and Technology at the 12th National Logistics Symposium and Exhibition. Alexandria , Virginia. 31 Oct. 1995. p 1-4. and Becker, David A., Lucy Capaldi., Heidi, Davered., and William Gooken. "Applying Commercial Practices and Technologies to Transportation." Logistics Spectrum. Mar/Apr 1997.p 1-8. All of these books and articles present numerous comparisons and recommendations for the military supply system including class IX repair parts to adopt civilian practices or to outsource the requirement to civilian industry completely.

[95]. US Army Regulation. 710-2, Inventory Management Policy Below Wholesale Level. Washington, DC: Department of the Army, 28 February 1994. p 4,1-17.

[96]. US Army. FM 63-3, Corps Support Command. Washington DC: Department of the Army, 30 September, 1993. p 3-4, 3-9. These pages describe the CMMCs mission and functions related to class IX repair parts management in the corps and US Army. FM 63-21, Main Support Battalion. Washington DC: Department of the Army, 7 August ,1990. p 2-2. This page describes the DMMCs mission and function as it relates to the Class IX repair parts management in the division.

[97]. Telephone interview conducted on 14 and 18 November 97. Interview conducted with a major automobile manufacturing corporation official. His responsibilities include management of automotive assembly materials and repair parts distribution for their corporations midwest assembly plant and automobile sales dealers in the state of Kansas and Missouri. The monograph author agreed not to publish this official or his corporations name in the article or in the notes due to normal industry proprietary concerns. During the interview he stated that this was his companies standard and that this was about the norm within the American automobile industry. However the Japanese automobile corporations standards were slightly better in most cases.

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[102]. Conrad, Scott W. Moving the Force, Desert Storm and Beyond. Wasington, DC: Institute _
for National Strategic Studies; and National Defense University. p 62.

[103]. US Army Regulation. 710-2, Inventory Management Policy Below Wholesale Level. p 45 and 53.

[104]. US Army Regulation. 710-2, Inventory Management Policy Below Wholesale Level. p 45, 53 and Telephone interview conducted on 14 and 18 November 97. Interview conducted with a leading automobile manufacturing corporation official.

[105]. Telephone interviews conducted on 14 and 18 November 97. Interview conducted with a leading automobile manufacturing corporation official.

[106]. US Army Regulation. 710-2, Inventory Management Policy Below Wholesale Level. p 37.

[107]. ibid. p 76.

[108]. Kaminski, Paul G. "The Revolution in Defense Logistics." p 5.

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[111]. US Army Regulation. 710-2, Inventory Management Policy Below Wholesale Level. p 44.

[112]. Telephone interviews conducted on 14 and 18 November 97. Interview conducted with a leading automobile manufacturing corporation official.

[113]. ibid.

[114]. ibid.

[115]. Heiser, Joseph M. A Soldier Supporting Soldiers. Washington, DC: US Army Center for Military History, 1991. p 137-139.

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[117]. Johnson, James C. and Wood, Donald R. Contemporary Logistics. New York , MacMillian Publishing Company, 1990. p 226. On this page, the author provides a series of quotes from civilian industry officials stating that the goals and objectives of supply management include: reduced inventory cost, and increased profits.

[118]. US Army Regulation. 710-2, Inventory Management Policy Below Wholesale Level. p 4.

[119]. McGee, Micheal L. " Just -in Time, or Just to Late " Army Logistician, Ft Lee Virginia. Mar-Apr 1994. p 15-17.

[120]. Kaminski, Paul G. "The Revolution in Defense Logistics." p 5.

[121]. Berman, Mortan B., Douglas W. McIver, Marc W. Robbins and John F. Schank. Evaluating the Combat Payoff of Alternative Logistics Structures for High-Technology Subsystems. The RAND Corporation R-3673, Santa Monica: CA, October 1988. p 42.

[122]. Army Regulation 11-8, Principles and Policies of the Army Logistics System. Washington, D.C.: Department of the Army, 18 March 1976, chap 3. The principles are listed below.

> LOGISTICS INTELLIGENCE: Commanders must have accurate and timely logistics information in order to provide effective support
> OBJECTIVE: Logistic endeavors must be directed toward a clear and attainable objective.
> GENERATIVE LOGISTICS: The professional application of initiative, knowledge, and ingenuity and the innovative exploration of technical and scientific advances are fundamental to the generation of logistics improvements.
> INTERDEPENDENCE: Logistic system efficiency requires effective interrelationship among parts of the system.
> SIMPLICITY: Logistics support must be provided in the right quantity and at the right time and place for accomplishment of the mission.
> TIMELINESS: Logistics support must be provided in the right quantity and at the proper

time and place for accomplishment
IMPETUS: The impetus of logistics support is forward to support the combat mission.
COST EFFECTIVENESS: Efficient management of Logistics resources is essential to cost-effective logistic support.
SECURITY: Security of every facet of the logistics system must be maintained to preserve resources and assure sustained combat capability.

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[124]. US Army Regulation 11-8, Principles and Policies of the Army Logistics System. Chapter 3.

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[131]. The Association of United States Army Special Report, "Operations Desert Shield and Desert Storm: The Logistics Perspective. Arlington, VA, Sept 1991. p 1.

[132]. Shrader, Charles R. United States Army Logistics 1775-1992: An Anthology Volume 3. p 761.

[133]. Report to the Chairman, Committee on the Armed Services, House of Representatives. "Operation Desert Storm: The Services Efforts to Provide Logistics Support for Selected Weapons Systems." Washington, DC: United States General Accounting Office, Sept 1991. p 4. In this report, the GAO concluded that the weakest link in the US Army's ability to sustain operations during Desert Shield/Storm was repair parts supply and distribution. The US Army's failure to properly plan for and sustain repair parts supply and distribution operations would have exhausted available class IX repair parts inventories.

[134]. ibid.

[135]. Report to the Chairman, Subcommittee on Oversight of Government Management, Committee on Governmental Affairs, US Senate. " Operation Desert Storm: Transportation and Distribution of Equipment and Supplies in Southwest Asia." Washington DC: United States General Accounting Office Accounting Office, Dec 1991. p 4

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[140]. Report to the Chairman, Subcommittee on Oversight of Government Management, Committee on Governmental Affairs, US Senate. "Operation Desert Storm: Transportation and Distribution of Equipment and Supplies in Southwest Asia. Dec 1991. p 10.

[141]. Report to the Chairman, Subcommittee on Oversight of Government Management, Committee on Governmental Affairs, US. Senate. "Operation Desert Storm: Transportation and Distribution of Equipment and Supplies in Southwest Asia." p 10-12.

[142]. ibid. p 4.

[143]. Report to the Chairman, Subcommittee on Oversight of Government Management, Committee on Governmental Affairs, US. Senate. " Operation Desert Storm: Transportation and Distribution of Equipment and Supplies in Southwest Asia." p 10-12.

[144]. Report to the Chairman, Committee on the Armed Services, House of Representatives. "Operation Desert Storm: The Services Efforts to Provide Logistics Support for Selected Weapons Systems." p 4 ; The Association of United States Army Special Report, "Operations Desert Shield and Desert Storm: The Logistics Perspective. p 28.

[145]. Pagonis, William G . Moving Mountains. Boston: Harvard Business School Press, 1992. p 206.

[146]. Report to the Chairman, Committee on the Armed Services, House of Representatives. "Operation Desert Storm: The Services Efforts to Provide Logistics Support for Selected Weapons Systems." Washington, DC: United States General Accounting Office, Sept 1991. p 4. In this report, the GAO concluded that the weakest link in the US Army's ability to sustain operations during Desert Shield/Storm was repair parts supply and distribution. The US Army's failure to properly plan for and sustain repair parts supply and distribution operations would have exhausted available class IX repair parts inventories.

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[148]. Daily Hayes, Margaret; Gary F. Wheatley. Interagency and Political-Military Dimensions of Peace Operations: Haiti -A Case Study. Washington DC: Feb 1996. p 10.

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